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ABSTRACT

Part of a four-volume study on highway safety activities, this report describes the need for breath examiners, accident investigators, emergency medical technicians, and highway engineering personnel. Training needs are discussed, in the context of curriculum, staffing, student recruitment, facilities, equipment, enrollment, and national objectives. Course outlines are appended. This volume is one of a series available as VT 013 312-013 315. (BH)

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EXPANSION OF VOCATIONAL-TECHNICAL PROGRAMS TO ACCOMMODATE HIGHWAY SAFETY MANPOWER REQUIREMENTS

Volume III

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EXPANSION OF VOCATIONAL-TECHNICAL SCHOOL PROGRAMS TO ACCOMMODATE HIGHWAY SAFETY MANPOWER REQUIREMENTS

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Expansion of Vocational-Technical School Programs to Accommodate Highway Safety Manpower Safety Requirements

Volume III

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ALCOHOL IN RELATION TO HIGHWAY SAFETY

I. INTRODUCTION

The use of alcohol by drivers and pedestrians leads to some 25,000 deaths and a total of at least 800,000 accidents in the United States each year. This is especially tragic in that much of the loss of life, limb, and property damage involves completely innocent parties.

The annual total of alcohol-involved fatalities on the highway exceeds the sum of (1) all the murders, and (2) twice the number of fatalities in railroad, marine and air transportation combined. This represents more than 40 percent of all the fatalities in all the transportation load.[1]

Most states have laws relating to the control of people who drive vehicles while under the influence of alcohol. *Highway Safety Program Standard No. 8: Alcohol in Relation to Highway Safety*, on June 27, 1967, called for the states to: 1) develop programs to reduce traffic accidents resulting from persons driving under the influence of alcohol; 2) establish specific test procedures for determining blood-alcohol content; 3) supplement existing "implied consent" authority; 4) develop a specification for the blood-alcohol concentration at which a driver may be deemed to be intoxicated (not to exceed 0.10 percent by weight); and 5) establish appropriate procedures for specifying the qualifications of personnel who administer chemical tests used to determine blood, breath, and other blood-alcohol concentrations.

Many states have already responded to the Standard, particularly in passing "implied consent" legislation and developing certification specifications for breath examiner specialists. "Implied consent" provisions of chemical test laws specify that any person who operates a motor vehicle is "deemed" to have consented to a chemical test when requested to submit to such a test by a law enforcement officer after being charged with driving under the influence of alcohol. Failure to give consent to such a test may be cause for suspension of driving privileges.

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[1] U.S. Department of Transportation. National Transportation Safety Board, *Alcohol Problems and Transportation Safety* (Washington, D.C.: U.S. Department of Transportation, National Transportation Safety Board, 1969), p. 2.

Another closely associated area of concern to highway safety officials and the general public is the use of drugs by increasing numbers of youths and adults. Ways and means for dealing with this problem are being given attention by highway safety officials as well as other interested parties and agencies across the United States.

II. GENERAL SUBJECT AND PROGRAM BACKGROUND

The Standard for Alcohol in Relation to Highway Safety has made it mandatory that each state develop a greater capacity to deal with the drinking-driving problem.

At the present time many local jurisdictions have means for determining alcohol concentrations, either through blood, breath, or urine tests. Two types of programs are generally found among local governments. These are: 1) blood tests administered by private doctors or hospital technicians, and 2) breathalyzer tests administered by law enforcement officials. Urine tests are not commonly administered. The position of breath examiner specialist may be filled by employees of sheriffs' offices, county police departments, or municipal governments. Personnel given the responsibility for conducting chemical tests for alcohol concentrations include sheriffs, deputy sheriffs, law enforcement officers and patrolmen, police chiefs, hospital laboratory technicians, nurses, and physicians.[2]

Chemical test specialists generally administer chemical tests on a part-time basis and are summoned as needed. In the past there have been only one or two such individuals qualified for administering chemical tests in each law enforcement agency. These individuals are not available for conducting chemical tests at all times, since they also handle other law enforcement responsibilities.

Today, new chemical test methods have been developed, new state laws have been enacted which relate to chemical tests, and new chemical test equipment has been introduced on the market which provides states additional means for coping with the drinking-driving problem.

A. SUMMARY OF TASKS TO BE PERFORMED BY BREATH EXAMINER SPECIALISTS

Breath examiner tests appear to be the most feasible method for efficiently and effectively determining alcohol concentrations of drivers under the influence of alcohol. Therefore, the breath examiner specialist has been singled out as the prime target for occupational training.

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[2] National Association of Counties Research Foundation, *Safety Manpower Survey of Local Governments in the United States* (Washington, D.C.: National Association of Counties Research Foundation, n.d.), p. 22.

The breath examiner specialist uses a breathalyzer instrument to make an analysis of blood-alcohol content by breath tests. These instruments are equipped with mechanical and electrical components and chemical reagents that interact with the flow of breath to give a calibrated reading of blood-alcohol content. Proper operation of the instrument requires that the breath examiner specialist prepare the instrument for operation, conduct a test and record its results in a written report. He may be required to testify in court.

B. MANPOWER PRESENTLY EMPLOYED AND FORECASTS OF MANPOWER NEEDS

Booz-Allen and Hamilton note two occupations relating to the National Highway Safety Standard on Alcohol Control. These are "alcohol technical specialist," and "breath examiner specialist," two job areas where training is urgently needed, according to the opinion of the authors.

Estimates of number of trained personnel needed for these two jobs (nationally) are listed in Figure 2, along with a maximum national estimate (Alternative 1) and a minimum national estimate (Alternative 2) by Booz-Allen and Hamilton.

In 1968, 826 persons were employed in these occupations. Booz-Allen and Hamilton believe, however, that to have maximally enforced the Standard, 15,353 persons were required that year. If this Standard would have been minimally met, 2,201 persons should have been employed in the two jobs in 1968. The 1971 requirements are estimated between 15,801 (maximum) and 2,256 (minimum) persons needed in the two occupations at the state level.

Other estimates (by the National Association of Counties Research Foundations) show a different figure. In a survey of local governments the NACRF estimated in 1969, 17,378 persons were needed to maximally enforce the safety standard. The anticipated need in 1971 will be 18,217 persons needed. This increase is estimated through 1978, when 21,155 persons are expected to be needed at the local level to maximally enforce the Alcohol in Relation to Highway Safety Standard.

FIGURE 1

ALCOHOL TECHNICAL SPECIALIST[3]

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
State Estimates	26	40	41	41	41	41	41	41	41	41
Alternative 1 (Maximum)	298	300	302	305	308	316	319	323	332	337
Alternative 2 (Minimum)	195	195	196	196	199	202	202	207	216	229

FIGURE 2

BREATH EXAMINER SPECIALIST[4]

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
State Estimates	800	844	862	878	893	908	923	941	941	941
Alternative 1 (Maximum)	15,055	15,274	15,499	15,614	15,961	16,125	16,443	16,691	17,176	17,435
Alternative 2 (Minimum)	2,006	2,032	2,060	2,090	2,120	2,152	2,183	2,211	2,247	2,277

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[3] Booz-Allen and Hamilton, Inc., *Safety Specialist Manpower*, Vol. 1., (Washington, D.C.: Booz-Allen and Hamilton, Inc., 1968), Appendix E.

[4] *Ibid.*

FIGURE 3

BREATH EXAMINER SPECIALIST SUPERVISOR[5]

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
National Estimate	104	107	110	113	116	119	122	125	128	132
Alternative 1 (Maximum)	2,172	2,225	2,277	2,329	2,382	2,434	2,487	2,539	2,592	2,644
Alternative 2 (Minimum)	724	741	759	776	794	811	829	846	864	881

FIGURE 4

BREATH EXAMINER SPECIALIST[6]

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
National Estimate	1,938	2,011	2,088	2,169	2,254	2,344	2,440	2,542	2,649	2,763
Alternative 1 (Maximum)	15,206	15,573	15,940	16,307	16,675	17,042	17,409	17,776	18,143	18,511
Alternative 2 (Minimum)	5,069	5,191	5,314	5,435	5,575	5,681	5,803	5,925	6,048	6,170

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[5] *Ibid.*

[6] *Ibid.*

III. PROGRAMS AND COURSES FOR TRAINING BREATH EXAMINER SPECIALISTS

Several states have developed recent legislation relating to chemical tests for intoxication. These legislative actions call for the motor vehicle divisions, the state boards of health, community-junior colleges and other agencies and institutions to cooperatively develop specifications for training specialists for alcohol testing. A few states have already implemented training.

The State of North Carolina has designated the North Carolina State Board of Health as the state agency governing alcohol tests within the state. The State Board of Health, designated the Department of Community Colleges to train specialists. The State Board of Health adopted regulations governing breath and blood-alcohol tests, the equipment used in administering these tests, the issuance and duration of permits, the character and competency of breath-test equipment operators and blood analysts. Advisory bodies have been set up to recommend policies and procedures.

To date, 147 North Carolina law enforcement agencies have had experience training breath examiner specialists, 315 of whom are now employed by the North Carolina Highway Patrol.[7]

In Wisconsin, a bill enacted in 1969 names the Wisconsin Division of Motor Vehicles to approve methods of chemical analysis of the breath. The same agency approves training manuals and courses throughout the state for training traffic officers in chemical analysis; certifies the qualifications and competencies needed by individuals to conduct such analysis; (accepts or rejects) equipment to be used by traffic officers for chemical analysis of a person's breath; and issue permits for personnel to conduct breath examinations. It is not certain, how many people are in training in these areas in Wisconsin.[8]

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[7] The Department of Community Colleges, North Carolina State Board of Education (information obtained through correspondence).

[8] State of Wisconsin. *Senate Bill 219: Amendments to Statutes Relating to Chemical Tests for Intoxication*, February 14, 1970.

IV. PROGRAM OR COURSE CURRICULA

Some progress has been made toward identifying the learning experience necessary for certification for breath examiner specialists, duration of training courses and suggested time intervals for retraining.

The North Carolina Department of Community Colleges requires three courses to qualify persons as breath examiner specialists.

A. Chemical Tests for Alcohol: Operator's School. This course provides 68 hours of instruction. If a student passes all phases of the course, he is recommended for certification to State Board of Health and issued a permit for 15 months at which time he is required to enroll for retraining.

B. Chemical Tests for Alcohol: Operator's Retraining School. This course provides laboratory practices and 28 hours of review of concepts and skills taught originally in the operator's school. Upon successful completion of course requirements, candidates are recommended for recertification. Personnel must successfully complete two of these retraining schools upon expiration of permits at 15 month intervals, after which they must attend a one-day evaluation course for permit renewal.

C. Chemical Test for Alcohol Technical Supervisors School. This course is 88 hours in duration. To be eligible to attend this course, students must have satisfactorily completed the operator's school.[9]

Subject elements to consider in developing curriculum materials for training breath examiner specialists are shown in Exhibit A in the appendix.

Booz-Allen and Hamilton, Inc., and the Stanford Research Institute have attempted to delineate duties of breath examiner specialists, and special training and/or experience necessary for entry and advancement in the field. Seqments of these efforts are exhibited in the appendix.

In order to assist the states in implementing the Standard for Alcohol in Relation to Highway Safety, states must have guidelines for determining how many people are needed for alcohol detection, how they should be trained, course subjects to be introduced, simulated experiences needed by trainees, duration of courses, etc., current guides are needed for instructional personnel. These guides should specify what type student should be admitted to the courses, the content of courses, equipment and facilities needed, caliber of faculty, audiovisual aids, lists of references, aides in developing lesson plans, and how to evaluate student performances. These instructors' guides should make use of common materials which could be interchanged in three types of courses--basic, refresher and advanced.

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[9] Department of Community Colleges, North Carolina State Board of Education (information obtained through correspondence).

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V. CONCLUSIONS

The following conclusions have been drawn from this unit:

A. Chemical tests for blood-alcohol content are vital to those responsible for implementing the Standard for Alcohol in Relation to Highway Safety. Breath analysis seems to be the most practical method for determining the blood-alcohol content of persons arrested by law enforcement personnel.

B. There is an insufficient number of qualified individuals to administer breath tests for blood-alcohol content. Breath tests entail special training.

C. The time required for administering breath tests for blood-alcohol content is an uncontrollable variable since accidents are unpredictable. Breath examiner specialists should be available on call. Generally most work on a part-time basis.

D. New chemical test methods have been developed and new state laws which relate to chemical tests have been introduced. Such new developments have helped alleviate drinking and driving problems.

E. Few states use public educational institutions to train breath examiner specialists. However, one state (North Carolina) is using community-junior colleges to train chemical test specialists.

F. Few published instructional materials exist for breath examiner specialists training. Articles that relate to training chemical test specialists have appeared in professional, technical, and trade magazines. Magazine articles are not readily accessible to instructors.

VI. DISCUSSION-RESEARCH QUESTIONS

The findings of this report reveal a number of questions. It is the authors' hope that each of the following questions may be carefully considered as discussion-research topics by a number of interested persons or groups.

A. Should breath tests for blood-alcohol content be administered by agencies other than law enforcement?

B. Should breath examiner specialists be available on a full-time basis to administer breath tests? If not, what strategy can be applied to assure a sufficient number of personnel for emergency situations?

C. Can programs for training breath examiner specialists be effectively administered by public educational institutions? If so, can all phases of instruction (basic, refresher, and advanced training) be administered by public educational institutions?

D. Are the problems associated with the use of drugs while driving common to the problems associated with the use of alcohol? If not, what are the unique aspects of each? Are state statutes relating to the chemical test for blood-alcohol concentrations concerned with blood-drug concentrations? What special training is needed to qualify personnel to detect the use of drugs by drivers? Can the breath examiner specialist be prepared to work in this area?

E. Is there a genuine need to provide instructional activities to prepare hospital laboratory techniques for roles as chemical test specialists?

F. Are unique knowledges and skills needed for preparing for and conducting blood-alcohol tests with different test equipment? If so, what are these knowledges and skills? Should all breath examiner personnel use the same equipment in administering blood-alcohol tests?

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APPENDICES

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EXHIBIT A

CHEMICAL TESTS FOR ALCOHOL*

I. Applied Mathematics and Science
  A. Mathematics -- Review
    1. Fractions
    2. Percentages
    3. Decimals
  B. Metric System
    1. History
    2. Presentation and problem solving
    3. Working problems
    4. Scientific concepts
      a. Specific gravity
      b. Density
      c. Absolute zero

II. Pharmacology and Physiological Effects of Alcohol
  A. History and types of chemical tests for alcohol in blood
    1. Separation of alcohol from body fluids
      a. Distillation
      b. Desiccation
      c. Aeration
    2. The measurement of alcohol in body fluids
      a. Photo-electric colorimeter
      b. Titration
      c. Color standards
      d. How the breathalyzer measures alcohol in the blood
  B. Alcohol and the human body
    1. Beverage alcohol
      a. Whiskey
      b. Brandy
      c. Wine
      d. Beer
      e. Medical alcohol
      f. Other distilled spirits
    2. Absorption of alcohol
    3. Distribution of alcohol
    4. Elimination of alcohol
    5. Accumulation of alcohol in the body
    6. Widmark's Hypothesis
    7. Alcohol tolerance

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*Selected from "Chemical Tests for Alcohol Program," North Carolina State Board of Education, Department of Community Colleges, 1970.

        - a. Consumption tolerance
        - b. Constitutional tolerance
  - C. Effect of alcohol on body organs
    - 1. Skin
    - 2. Gastrointestinal tract
    - 3. Heart and circulation
    - 4. Liver and kidneys
  - D. Effects of alcohol on the central nervous system
    - 1. The brain
    - 2. Vision and hearing
    - 3. Muscles
      - a. Voluntary
      - b. Involuntary
    - 4. Judgment and self-control
      - a. Euphoria
      - b. Loss of inhibitions

III. Background and History of Chemical Testing
  - A. Previous international "works" in the chemical test field
  - B. Development of chemical testing instruments

IV. Theory of the Breathalyzer
  - A. Nomenclature and function
  - B. Operational procedure
  - C. Collecting the sample
  - D. Passing the sample through the solution and measuring the amount of potassium dichromate required to oxidize the alcohol
  - E. Maintenance of the breathalyzer (lecture and demonstration)
    - 1. Preventive maintenance
    - 2. Common failures
    - 3. Corrective action

V. Legal Issues of Breath-Alcohol Testing
  - A. State law governing intoxicating liquor and driving under the influence
  - B. State law governing chemical tests
    - 1. Presumptive level
    - 2. Implied consent
  - C. State Board of Health rules and regulations
  - D. Rules of evidence
  - E. Constitutional issues
  - F. Supreme Court decisions
  - G. Expert witnesses
  - H. Independent tests
  - I. Advise defendant of results
  - J. Certification of chemical test equipment operators

VI. Supervision of Chemical Test Program
- A. "Selling" program
  - 1. A short course on the breathalyzer
    - a. Operation of the breathalyzer
    - b. Alcoholic influence report form (National Safety Council)
    - c. Physical layout for testing
    - d. Standard operating procedure
    - e. Law regarding chemical tests and operating automobile under the influence
    - f. Maintenance of the instrument
    - g. "Live" demonstration of chemical testing
- B. Preparation for court
  - 1. Chemical supply
    - a. Number of chemicals to order (based on records)
    - b. Storage of chemicals
    - c. Random sample testing
      - 1) Random sample testing should be performed by an independent laboratory or agency
      - 2) Affidavit should be obtained from the chemist indicating the test results
  - 2. Calibration of the instrument
    - a. "Preventive maintenance check list"
    - b. Equilibrator or simulator test
      - 1) Obtain source for stock supply
      - 2) Obtain chemist to certify accuracy of the instrument
      - 3) Maintain a supply of the solution for subsequent tests by the operator
    - c. Perform blood correlation tests with controlled drinking subjects
    - d. Test "live" subjects for experience
  - 3. The need for outside experts
- C. Standard operating procedures
  - 1. Conditions for which subject may be arrested
    - a. Misdemeanor committed in the presence of officer (arrest without a warrant)
    - b. Arrest where officer did not see individual operate a vehicle
      - 1) Arrest for public drunkeness
      - 2) Arrest for other offense
  - 2. Procedures for arresting
    - a. Obtain warrant for operating automobile under the influence
    - b. Record time of actual arrest at the scene
    - c. Advise department of a drunken driver arrest
    - d. Request preparation for chemical test

3. Procedure after arresting subject
    a. Request defendant to take breath test
    b. Complete alcoholic influence report form and conduct physical test
    c. Conduct breath test per instructions
4. Procedure following test
    a. Advise defendant of results (orally)
    b. Preserve test record and check list for court presentation
    c. Assist defendant to obtain private tests, if required
    d. "Form for defendant," showing time of arrest and test results, should be given to defendant or his attorney
    e. Use departmental procedure regarding confinement, bail, etc.
5. Special situations
    a. Test results - below .10 percent and symptoms greater than level indicated
        1) Inquire further, look for drugs, injuries or illness
        2) Perform additional tests, if warranted
    b. Test results - above .35 percent
        1) Wait 30 minutes, retest
        2) If absorbing, take the defendant-examinee to the hospital

VII. Laboratory Instructions and Practice
    A. How to operate the breathalyzer
        1. Introduction to breath test instruments
        2. Terminology
        3. Operation procedure
    B. Breath alcohol simulator
        1. History
        2. Operation of simulator
        3. Formula for mixing simulator solutions
    C. Practice
        1. Running known solution in breath alcohol simulators
        2. Test for garlic, onions, and acetone
    D. Supervised laboratory with drinking subjects
        1. Instruction as to laboratory project with drinking subjects
        2. Performance of various physical and mental tests by drinking subjects, before drinking
        3. Drinking of prescribed quantity of alcoholic beverages
        4. Testing of drinking subjects
        5. Performance of various physical and mental tests by drinking subjects, after drinking

    6. Plotting blood-alcohol curve of drinking subjects
    7. Summary and review of laboratory project
  E. Laboratory examination--running unknown simulator solutions

VIII. Drugs in Relation to Highway Safety

EXHIBIT B

BREATH EXAMINER SPECIALIST*

Scope

Consists of Police Traffic Services Patrolmen qualified to asminister breath tests at a field unit headquarters.

Duties

Administers breath tests to individuals suspected of driving under the influence of alcohol. Operates and maintains examining equipment. Testifies, as required in court, and reports on activities.

Entering Education

High school graduate or the equivalent.

Entering Experience

A minimum of four years as a Police Traffic Services Patrolman or the equivalent.

Special Training

- A minimum of 40 hours preservice training in the background of the highway safety program, in alcohol in relation to highway safety, in operation and maintenance of test equipment, in courtroom testimony, and in report writing.
- A minimum of 16 hours annual in-service training devoted to review of preservice training and to examination of new developments within the alcohol program.

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*Extracted from *Safety Specialist Manpower*, Vol. I, Booz-Allen and Hamilton, Inc., 1968. Appendix B.

EXHIBIT C

BREATH EXAMINER SPECIALIST*

Entry Training		Refresher Training		Percent of Total Training Hours by Discipline		
Course Description	No. of Hours	Course Description	No. of Hours	Law	Public or Bus. Admin.	Police Science
A. The Background of the Highway Safety Program.	10	A. A Review and Examination of New Development within the Alcohol Program.	16 YR.	25	50	25
B. Courtroom Testimony Regarding Alcohol Problems in Highway Safety	5					
C. Report Writing in Connection with Alcohol Problems in Highway Safety.	5					

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*Extracted from *The Feasibility of Establishing Highway Safety Manpower Development and Research Centers at University-Level Institutions*, Vol. 1. Stanford Research Institute, 1969. p. 10.

IDENTIFICATION AND SURVEILLANCE OF ACCIDENT LOCATIONS

I. INTRODUCTION

The identification and surveillance of traffic and roadways for detection and correction of high or potentially high accidents is part of the "pre-crash" phase of the highway safety program. The National Highway Safety Bureau and the Bureau of Public Roads are supporting programs that are directed at reducing the "crash initiation factor" which results from deficiencies in design, construction, and maintenance and deterioration of roadways due to time and use. The campaign to improve roadway conditions at hazardous locations is commonly referred to as "spot" improvement. This program is concerned with specific locations identified as hazardous because of a high accident experience.

> Detection of hazardous elements and locations becomes more complex after corrections have been applied to the obviously high accident "spots." An effective detection and correction program must be based on a thorough analysis of accident occurrence and causal factors. This applies to upgrading existing design elements as well as eliminating "spot" hazards.
>
> . . . Despite all efforts to eliminate hazards, some simply cannot be removed. Instead, motorists must be protected from them by devices which, when installed, reduce the hazard level. Much progress has been made lately in this field, and devices considered of value a few years ago are now being replaced or modified. Changes in design concepts to achieve reductions in the severity of off-the-road accidents also contribute to this area.[1]

Highway Safety Program Standard No. 9: Identification and Surveillance of Accident Locations, was promulgated June 27, 1967, by the National Highway Safety Bureau. The Standard calls for each state to develop a program which will provide for: 1) accurate identification of accident locations on all roads and streets, and the causes and effects of accidents at these sites; 2) appropriate measures to minimize hazardous conditions; 3) evaluation of the effectiveness of road and street improvements at these locations; 4) continuing surveillance in an effort to locate potential accident locations.

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[1] U.S. Senate, *Report on the Status of the Federal Aid Highway Program*, 91st Cong., 2d sess. (Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, April 15, 1970), p. 131.

It can be seen that this Standard relates to several others (Highway Design, Construction, and Maintenance Standards, Traffic Control Devices, Traffic Records) all of which have been written and issued by the U.S. Department of Transportation to achieve overall highway improvements across the nation. It will take a correlation of elements from each of these standards to reach a level of marked improvement in national highway safety in the next few years.

The National Highway Safety Bureau recognizes a national need for specially trained personnel for roles in identification and surveillance of accident locations. These would assumedly be specialists hired by local police departments, highway departments, and traffic engineering divisions.

Need for such specialists arises from traffic investigation reports which have provided a singularly important cornerstone for traffic research. Such reports are normally recorded by officers who are employed by local and state police departments, state highway departments and city engineering divisions. The flaw in most of these reports is that investigation by police traffic personnel normally does not result in an intensive enough investigation of why accidents occurred. Because of this reason, a move is underway to develop a more comprehensive program within every state for reporting accidents, defining and redefining their causes and ultimately rebuilding or altering locations that are determined to be hazardous.

The passage of the Highway Safety Act of 1966 and subsequently the *Highway Safety Program Standard No. 9: Identification and Surveillance of Accident Locations*, has apparently provided the motivation for states to move forward into more comprehensive programs of altering hazardous road conditions and of creating jobs and personnel-units at local levels for identification and surveillance of accident locations.

A. SUMMARY OF THE TASKS TO BE PERFORMED BY ACCIDENT SITE INVESTIGATORS

It has previously been stated that police traffic personnel have rendered a significant service in investigating accidents and in recording the causes and effects of these accidents. Also, highway departments, local traffic engineering departments, automotive engineering departments, etc., have performed noteworthy limited tasks in the identification and surveillance of accident locations. These past records have been used extensively by a multiple number of state and local agencies having major traffic safety responsibilities to reduce hazardous highway conditions. However, the increase in traffic on United States major highways seems to indicate that today additional personnel are needed if current standards are to be met. Such personnel need to be identified by title, by specific training for their positions and by specific designation of duties in connection with forthcoming moves to increase highway safety.

1. ACCIDENT SITE INVESTIGATOR

The Accident Site Investigator in most cities, towns and counties in the United States is not a man employed by that title for that position. More popularly, he is a traffic officer or law enforcement supervisor or staff member of a law enforcement agency who happens to be given the job of investigating accidents along with many other routine responsibilities. The authors recommend (as do highway experts who are investigating possible avenues of highway changes) that a position be created on the local and on the state levels for a person known as "Accident Site Investigator."

Such a person should be responsible for developing methods and techniques to determine potentially high accident locations; analyzing and interpreting information on dangerous locations; investigating contributory factors in accidents; experimenting in control devices and in traffic flow changes; preparing plans for traffic pattern change and for new controls and presenting these plans and recommendations to officials with influence for bringing about change.

2. ACCIDENT SITE INVESTIGATOR AIDE

The Accident Site Investigator's duties would be such that he would in all probability need at least one aide trained in assisting him in maintenance of a cross-reference system of accident data; in retrieval of past collision data concerning vehicle, driver, location, etc.; in identifying and, if need be, analyzing peripheral information relating to the accident; in selecting (or ranking) which of many accident locations should receive top priority for expenditures for reducing highway deaths and injuries; in preparing recommendations, diagrams and engineering documents for officials responsible for removing or reducing factors contributing to injuries and property damage; in evaluating the effectiveness of improvements as they are made.

B. MANPOWER PRESENTLY EMPLOYED AND PROJECTIONS OF MANPOWER NEEDS

In Figure 1 in a survey by Booz-Allen and Hamilton, Inc., only 175 full-time State Accident Site Investigators were needed (according to states which answered the survey) in the year of 1968. That same year, survey expertise estimated that a maximum of 3,261 full-time State Accident Site Investigators were needed to do an effective job across the nation. Many states did not respond to the survey. Of those that did respond, 291 full-time Accident Site Investigators on a state level were said to be needed in 1971 as against the official estimate that 3,333 would be needed across the nation to do an effective job.

Greater emphasis is needed for full-time Accident Site Investigators and Aides in cities, counties, and states across the nation.

Figures 3 and 4 refer to a study conducted by another group, (The National Association of Counties Research Foundation) who surveyed local communities across the nation and of those that responded, only 614 Accident Site Investigators were shown to be employed in 1969. That same year the survey authors estimated that a need existed in communities across the nation for 9,617 full-time Accident Site Investigators.

In 1971, the same local communities across the nation said they might need a total of 659 Accident Site Investigators whereas the official survey estimate for the year 1971 is almost 15 times greater or 9,617 full-time Investigators needed in communities across the nation to reach national standards for records of highway accidents.

FIGURE 1

ACCIDENT SITE INVESTIGATOR[2]

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
State Estimates	175	246	280	291	299	308	314	321	321	321
Alternative 1 (Maximum)	3,261	3,287	3,312	3,333	3,365	3,392	3,418	3,444	3,472	3,494
Alternative 2 (Minimum)	1,474	1,475	1,493	1,508	1,517	1,530	1,541	1,550	1,562	1,579

FIGURE 2

ACCIDENT SITE INVESTIGATOR AIDE[3]

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
State Estimates	97	139	85	189	192	194	196	199	199	199
Alternative 1 (Maximum)	2,180	2,187	2,213	2,225	2,240	2,262	2,276	2,289	2,306	2,324
Alternative 2 (Minimum)	1,037	1,037	1,047	1,055	1,064	1,074	1,081	1,086	1,098	1,102

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[2] Booz-Allen and Hamilton, Inc., *Safety Specialist Manpower* (Washington, D.C.: Booz-Allen and Hamilton, Inc., 1968), Vol. 1, Appendix E.

[3] *Ibid.*

FIGURE 3

ACCIDENT SITE INVESTIGATOR[4]

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
National Estimate	614	636	659	682	706	732	758	785	813	842
Alternative 1	9,617	9,617	9,617	9,617	9,617	9,617	9,617	9,617	9,617	9,617
Alternative 2	4,723	4,723	4,723	4,723	4,723	4,723	4,723	4,723	4,723	4,723

FIGURE 4

ACCIDENT SITE INVESTIGATOR AIDE[5]

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
National Estimate	2,993	3,100	3,211	3,326	3,445	3,568	3,694	3,826	3,963	4,104
Alternative 1	2,807	2,807	2,807	2,807	2,807	2,807	2,807	2,807	2,807	2,807
Alternative 2	1,987	1,987	1,987	1,987	1,987	1,987	1,987	1,987	1,987	1,987

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[4] National Association of Counties Research Foundation, *Safety Manpower Survey of Local Governments in the United States* (Washington, D.C.: National Association of Counties Research Foundation), p. E-4.

[5] *Ibid.*

II. PROGRAM CURRICULA FOR TRAINING ACCIDENT SITE INVESTIGATION PERSONNEL

Curricular materials are available from a number of sources. State highway patrol academies, local police departments, community-junior colleges (through law-enforcement-police science programs) provide instruction in accident investigation. The National Highway Safety Bureau through Battelle Memorial Institute, Columbus, Ohio, will disseminate a course guide for accident site investigation training by August, 1971. The guide, prepared under contract by Battelle, is intended to answer who investigates, what is involved, levels of conducting an investigation, data and who uses it; and it is to be utilized by local and state police departments, state highway personnel, city traffic engineering departments, junior colleges and universities. The guide will include an outline of subjects for training investigators as well as alternative ways of preparing for the investigator position.

The California Highway Patrol Academy recently prepared a manual designed to supplement classroom instruction for accident investigators and to serve as a reference for investigators in the field. An outline of topics from the manual may be found in the appendix, Exhibit A. The California manual is oriented toward enforcement. Future manuals are expected to be slanted toward the engineering aspects of highway safety inasmuch as there is increased in this direction in highway safety circles throughout the country.

Booz-Allen and Hamilton, Inc. and the Stanford Research Institute have made initial efforts to determine the scope of accident site investigation, the duties required of accident site investigation personnel, and special training and/or advancement necessary for entry and advancement in the field. Segments of these efforts are presented in the appendix in Exhibits B, C, D, and E.

III. CONCLUSIONS

A. Detection of hazardous street conditions has brought about limited success in reducing highway accidents, concomitant injuries and property damage. Greater effort is needed in precluding future accidents by predetermining which are possible accident locations and in altering and correcting conditions at these locations through surveillance (under different weather/traffic conditions), study and analyses. Known hazardous locations often receive immediate priority repair, but long-range programs are needed which would result in prediction of hazardous highway locations and their correction.

B. Most of the investigations into the causes and effects of accidents have been conducted by state and local police traffic personnel. Although the investigations are generally primarily concerned with law enforcement functions, the data provided by these persons have been the cornerstone for highway improvement and traffic research.

C. There is a need for specially trained personnel: to develop and implement procedures for identifying locations on highways and streets with high, or potentially high accident frequencies; to thoroughly analyze each situation to determine features with which accident frequencies or severities are associated; to coordinate efforts with appropriate personnel to correct the hazardous situations; and to maintain continuing surveillance over the roadway network to identify hazardous or potentially hazardous conditions.

D. A limited number of curriculum materials which relate to identification and surveillance of accident locations are available from state and local police traffic services agencies. These materials lack substantive elements needed in planning and conducting training programs for accident site investigation personnel, e.g., instructor qualifications and equipment and supplies needed for conducting a program of instruction and are more heavily oriented toward law enforcement function than highway design, construction, and maintenance. Additional National Highway Safety Bureau sponsored materials are forthcoming.

E. Personnel already employed in the identification and surveillance of accident locations could benefit from periodic inservice refresher training.

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IV. DISCUSSION-RESEARCH TOPICS

The findings of this report raise a number of questions. It is the authors' hope that each of the following questions may be carefully considered as discussion-research topics by a number of interested groups.

A. Should all accident site investigation personnel be responsible for law enforcement actions as well as data and information on causative factors of traffic accidents? Should accident site investigation personnel be primarily concerned with the pre-crash and post-crash phases of highway safety (in addition to the crash phase)?

B. Will most future accident site investigation personnel be employed in law enforcement agencies? If so, why? Would traffic engineering departments be the most feasible employment department for these people? If not, why not? Is it logical to assume that some may be employed in both law enforcement agencies and traffic engineering departments?

C. What knowledges and skills are common today to accident site investigation personnel and traffic engineering aides? Are traffic engineering aides normally qualified to perform activities in the identification and surveillance of accident locations?

D. Is it logical to assume that non-B.S. degree personnel can be prepared for roles as Accident Site Investigators as well as Accident Site Investigator Aides? Can one program be structured to allow students the option of training as Accident Site Investigator Aides? How would each option differ (time allotment, subjects, etc.)? Can a career ladder be developed around this one training program that will benefit the new trainee as well as personnel already employed?

E. Who should approve the content of training programs? Who should be given the responsibility for supervising programs of instruction? Who should be responsible for providing instruction?

F. What materials are initially needed to implement training for accident site investigation personnel (basic, advanced, and instructor training materials--curriculum guides, lesson plans, student-oriented materials, etc.)?

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APPENDICES

EXHIBIT A

ACCIDENT INVESTIGATION*

- I. Vehicle Crashes
  - A. Problems
  - B. Solutions

- II. Background on Accident Investigation
  - A. Comparison of accident investigation to other types of police investigation
  - B. Uses of accident data
  - C. Types of accident arrests
  - D. Qualities of accident investigation personnel
  - E. Terminology
  - F. Types of accident investigation
    - 1. Normal
    - 2. Late reported
    - 3. Hit-and-run

- III. Accident Investigation Procedure
  - A. Value of fixed procedure
  - B. Protection of life and property
  - C. Arrival at the scene
  - D. Protecting the scene of the accident
  - E. Administering first aid
  - F. Gathering evidence
    - 1. Factors to consider
      - a. The highway
      - b. The vehicle
      - c. The roadway
    - 2. Questioning the drivers and witnesses
    - 3. Checking drivers for physical and mental conditions (including intoxication)
    - 4. Examining the vehicle
      - a. Determining damages
      - b. Determining if proper safety devices are installed and operative
      - c. Determining other automobile malfunctions
    - 5. Examining the surrounding physical conditions
      - a. Holes in the road
      - b. Debris on the pavement
      - c. Driving visability
    - 6. Preparing a sketch of the scene
    - 7. Taking photographs of the scene

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*Selected from *Accident Investigation* (Sacramento, California: Department of California Highway Patrol, Office of Training Division, 1970), pp. 1-46.

- H. Causes of accidents
    - 1. Collision
    - 2. Non-collision
    - 3. Direct cause
    - 4. Mediate cause
- I. Enforcement action
- J. Hit-and-run investigation
- K. Witness and driver statements

IV. Determination of Speed from Skid Marks

EXHIBIT B

ACCIDENT SITE INVESTIGATOR*

Scope

Includes all professional state employees who perform thorough investigations of accident sites, including personnel with either engineering or enforcement backgrounds.

Duties

Performs investigations of accident sites to collect data concerning causes of and factors contributing to accidents. Analyzes data and prepares recommendations for engineering and enforcement measures that might be enacted to reduce accidents and their effects. Provides supervision to Accident Site Investigator Aides.

Entering Education

Masters degrees in traffic engineering, bachelors degree in civil engineering, or the educator of a Police Traffic Services Officer.

Engineering Experience

A minimum of two years as a traffic engineer, four years as a highway engineer in design, construction, or maintenance, one year as a Police Traffic Services Officer, or the equivalent.

Special Training

- Upon appointment, a minimum of one in-service university level course providing general knowledge of the relationship of highway design, construction, maintenance, traffic operations, and enforcement to the prevention and reduction of accidents or the alleviation of their aftereffects. Also, one university level course of a semester's duration in one of three areas of specialty

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*Extracted from *Safety Specialist Manpower*, Vol. I, Booz-Allen and Hamilton, Inc. (Washington, D.C.: Booz-Allen and Hamilton, Inc., 1968).

(traffic operations, highway engineering, and enforcement) providing in-depth knowledge of the relationship between that specialty and the prevention and reduction of accidents or the alleviation of their aftereffects.

- At least 40 hours attendance triennially in a university level course to review previous training and to examine new developments within the field.

EXHIBIT C

ACCIDENT SITE INVESTIGATOR AIDE*

Scope

Includes all state employed technically trained aides to Accident Site Investigators, including personnel with either engineering or enforcement backgrounds.

Duties

Under the supervision of Accident Site Investigators, aids in investigating accident sites in order to collect data concerning causes of and factors contributing to accidents. Assists in the analysis of data and preparation of recommendations for engineering and enforcement measures aimed at removing or reducing factors contributing to accidents and their effects.

Entering Education

High school graduate or the equivalent.

Entering Experience

At least three years of progressively responsible experience in highway planning, surveys, design, construction, maintenance, operations, enforcement, inspection, laboratory, research, related fields, or the equivalent.

Special Training

- Upon appointment, a minimum of 120 hours training at the junior college level, of which 40 hours should be devoted to obtaining a general knowledge of the highway safety program and of the relationship of highway design, construction, maintenance, traffic operations, and enforcement to the prevention and reduction of accidents or the alleviation of their aftereffects; 80 hours should be devoted to acquiring the requisite technical skills

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*Extracted from *Safety Specialist Manpower*, Vol. I, Booz--Allen and Hamilton, Inc. (Washington, D.C.: Booz-Allen and Hamilton, Inc., 1968).

for accident site investigation data collection and analysis.

- A minimum of 24 hours in-service training for the purpose of reviewing previous training and examining new developments within accident site investigation.

EXHIBIT D

ACCIDENT SITE INVESTIGATOR*

Entry Training		Refresher Training		Percent of Total Training Hours by Discipline		
Course Description	No. of Hours	Course Description	No. of Hours	Public or Bus. Admin.	Police Science	Engineering
A. General Knowledge of Relationship of Highway Design, Construction, Maintenance and Traffic Operations, and Enforcement to the Prevention and Reduction of Accidents or the alleviation of their aftereffects.	40	A. A Review and Examination of New Developments within Accident Site Investigation.	40 Tri.	5	25	70
B. In-depth Knowledge of the Relationship between Traffic Operation, Highway Engineering, or Enforcement and the Prevention and Reduction of Accidents or the alleviation of their aftereffects.	40					

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*Selected from *The Feasibility of Establishing Highway Safety Manpower Development and Research Centers at University-Level Institutions*, Vol. I, Stanford Research Institute, 1969, p. 10.

TRAFFIC RECORDS

I. INTRODUCTION

There are more than 1,400,000 problem drivers on the nation's streets and highways. The National Driver Register Service, a federal-state cooperative records exchange system, has a file containing the records of each problem driver identified in each state. This record system enables driver license examiners in each state to electronically search each new driver license applicant against the national file and obtain an instantaneous response.[1]

The National Highway Safety Act of 1966 recognizes the importance of a uniform, central traffic records system within each state and calls for a standard to be developed which would require states to upgrade their traffic records systems and their collection of raw data. The Highway Safety Standard for Traffic Records was promulgated on June 27, 1967. The Standard calls for each state to develop a statewide traffic records system and subsystems that would lend support to rapid encoding, storage, retrieval, summary, analysis, and dissemination of traffic data. Each state system is to be capable of furnishing summaries, tabulations, and special analyses to local governments. Subsystems are to be capable of providing data to the state system.[2]

The Standard for Traffic Records calls for each state to develop a records system which includes much information compiled through programs in other areas of highway safety (Periodic Motor Vehicle Inspection, Driver Licensing, Motor Vehicle Registration, Traffic Courts, Identification and Surveillance of Accident Locations, and Police Traffic Services).

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[1] U.S. Congress, *Message From the President of the United States Transmitting the First Annual Report on the Administration of the Highway Safety Act of 1966*, 90th Cong., 2d sess. (Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1968), p. 75.

[2] U.S. Department of Transportation, National Highway Safety Bureau, *Highway Safety Program Standard 10: Traffic Records* (Washington, D.C.: U.S. Department of Transportation, June, 1967).

II. BACKGROUND

Reliable statistical analyses are not always available for highway safety researchers even with the advent of the computer. Traffic data gathered on a local level is not always compatible with records maintained by the state even though traffic courts and law enforcement agencies at the local level routinely channel data into state record files. Primary providers of all traffic information today are courts, law enforcement agencies, and motor vehicle administration, licensing and registration agencies.

There may be in the next 10 years within each state a nucleus of a modern, computerized traffic records network. If this comes about, it will necessitate both training new personnel and switching personnel from other agencies engaged in highway safety.

Prior to the promulgation of the Highway Safety Program Standard for Traffic Records, few people were employed full-time in the development and maintenance of traffic records systems. Now, there is a developing need for traffic records analysts, electronic data processing operators, and clerical personnel to work full-time in developing systems, and/or encoding, storing, retrieving, analyzing and disseminating traffic data. An increasing number of trained personnel are needed in supervisory and administrative positions. An even larger number of supportive and research personnel will be needed in the next few years. Duties required of most of these personnel involve compiling of figures, collecting, transferring, systematizing and distributing traffic information. A job definition is important for each job. Analysis, scope of each "job," and specific tasks to be assigned specific personnel should be delineated. Curriculum materials should be continually developed, refined and disseminated with the hope of eventual nationwide unity in both training of traffic-records personnel and assigning curriculum materials that are to be used.

Finally, training for personnel should involve an exchange of information gathered through close liaison between state and local police agencies, county sheriffs' offices, highway departments, traffic engineering divisions, motor vehicle registration departments, driver licensing bureaus and other agencies which could conceivably make continuous and vital input into the "system."

III. CONCLUSIONS

The following conclusions have been drawn from this unit:

A. The Highway Safety Program Standard for Traffic Records calls for developing and maintaining a traffic data base, compiled from many highway safety activities, such as periodic motor vehicle inspection, and driver licensing. In highway safety, as in other fields, it is difficult to determine where the emphasis on manpower training and resource allocation should be placed. The need for curriculum development and occupational training is evident in many highway safety areas.

B. Prior to the promulgation of the Highway Safety Program Standard for Traffic Records, few people were employed full-time in the development and maintenance of traffic records systems. Manpower is needed today in this area if the Standard is to be met.

C. Most traffic records jobs are clerical and business in nature, not unlike personnel working in any other records system. It is difficult to identify specific occupations which require a significant degree of highway safety knowledge, still, the exact role of clerical workers, business operational workers, and supervisory workers should be clarified before training activities are initiated.

IV. DISCUSSION-RESEARCH TOPICS

The findings of this report raise a number of questions. It is the authors' hope that each of the following questions may be carefully considered as discussion-research topics by interested groups and individuals.

A. How can strong links be established between the central traffic records system with each state and each of the highway safety agencies that will be making inputs into the traffic records systems? How may key personnel in traffic records be brought together to assist in planning and developing manpower training?

B. Which occupations represented within traffic records systems require a significant degree of highway safety knowledge? What highway safety competencies are needed by workers in each of these occupations? Are personnel in these occupations needed on a full-time basis to perform tasks in traffic records systems?

C. Should training emphasis be initially placed on preparing new personnel for roles in traffic records systems, or providing in-service instruction to personnel already employed?

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EMERGENCY MEDICAL SERVICES

I. INTRODUCTION

The Highway Safety Act of 1966 directed the Secretary of Transportation, acting through the Director of the National Highway Safety Bureau to institute a highway safety program designed to reduce traffic accidents and consequent injuries, loss of human lives and loss of property. The Act recognized the importance of emergency services and required a standard to cover this aspect of highway safety. As a result, *Highway Safety Program Standard 11: Emergency Medical Services*, was promulgated on June 27, 1967.

Succinctly stated, the purpose of the Emergency Medical Services Program Standard is to provide an emergency care system that will: 1) provide quick identification and response to accidents; 2) sustain and prolong life through proper first aid measures, both at the scene and in transit; and 3) provide coordination, transportation, and communications necessary to bring the injured and definitive medical care together in the shortest practical time without simultaneously creating additional hazards.

In order to comply with this standard each state must institute a program to ensure that persons involved in highway accidents receive prompt emergency medical care. In defining what an emergency medical program should include, the American Medical Association states that an emergency is "an unforeseen combination of circumstances which calls for immediate action." In the context of medical services, the emergency can be of any magnitude, from single traffic casualty or cardiac arrest to a fire, an explosion, or a hurricane.

The American Medical Association further asserts the four basic components to a good emergency care system: 1) broad-based training for on-the-spot first aid; 2) a communications system which assures prompt response to the need; 3) well-equipped emergency vehicles, staffed by emergency medical technicians--ambulance, trained and equipped to provide all necessary life support at the scene and during transportation; 4) high quality emergency care facilities, staff and equipment at the hospital level; and that these four should be coordinated toward the single goal of quality care for the emergency victim.

II. IDENTIFICATION AND CLASSIFICATION OF PROGRAM AND OCCUPATIONS

There has never been synchronization of emergency medical job classifications on the national, state, and local levels. For instance, two major job/occupations/categories exist in medical emergency services--emergency medical technician and ambulance driver. Each of these two jobs are known by different titles. The emergency medical technician may be known as an ambulance attendant, first-aid attendant, emergency attendant, or rescue squadsman.

On a national level, the U.S. Office of Education manual for program classification categorizes emergency medical occupational educational programs under "Medical Emergency Services." (The code number is 07.0907.) In the *Dictionary of Occupational Titles*, put out by the U.S. Department of Labor, the same jobs referred to above are listed as First Aid Attendant (345.878-010), Ambulance Attendant (355.878-010), and Emergency Entrance Attendant (355.878-026).

There are efforts underway to correlate the jobs with job descriptions and classification. Such efforts logically result in the states and the federal government relooking at the occupations, what is required in each occupation, and how each occupation might uniformly be termed throughout the nation. These efforts will undoubtedly make future reporting by local educational agencies and the U.S. Office of Education a more simplified and meaningful procedure.

III. GENERAL SUBJECT AND PROGRAM BACKGROUND

The responsibility for emergency medical services is divided among various governmental agencies and private firms. At the governmental level, emergency medical services are most often provided through fire and police departments. Volunteer fire departments, highway departments, public schools, hospitals, and funeral homes, also provide for emergency medical services in many communities.

Emergency medical services functions may be conducted on a full-time basis or part-time basis, depending upon the population of the county or municipality. Personnel involved in emergency operations include ambulance drivers, emergency medical technicians (attendants) and dispatchers. Dispatchers often are involved with other activities in addition to emergency medical services. It appears that most emergency medical services are short-staffed, that personnel are responsible for many jobs instead of one and that a great shortage of manpower occurs when multi-emergencies arise.

A. MANPOWER REQUIREMENTS

In 1968, Booz-Allen and Hamilton (p. 50) estimated that a minimum of 37,510 persons were needed in emergency medical services occupations in the United States. No breakdown as to specific occupations and manpower requirements were given.

Figures 1, 2, and 3 show the results of a research study conducted by the National Association of Counties Research Foundation. These manpower figures pertain to three occupations within the Emergency Medical Services Standard--"dispatcher," "driver," and "attendant," at the local level (county, municipality, township, and school district units of government).

This study estimated that in 1969, 45,251 persons should have been employed in the occupations listed to minimally (alternative 2) enforce the Emergency Medical Services Standard and that 290,110 persons should have been employed to maximally enforce this standard. In 1971, a minimum of 45,621 persons should be employed; to maximally enforce the standard, 291,609 persons should be employed. It will be noted that the "national estimate" (estimate from counties, townships, etc., across the country and "alternative 2 (minimum)" are always the same.

By 1978, this report estimates that a total of 46,980 persons will be needed in order to minimally meet the standard. To maximally meet this standard in 1978, 301,530 persons will be needed in the occupations of ambulance dispatcher, driver, and attendant.

FIGURE 1

CHIEF DISPATCHER AND DISPATCHER[1]

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
National Estimate	4,369	4,388	4,407	4,426	4,445	4,465	4,485	4,505	4,525	4,545
Alternative 1	14,448	14,510	14,572	14,635	14,698	14,761	14,824	14,888	14,952	15,016
Alternative 2	4,369	4,388	4,407	4,426	4,445	4,465	4,485	4,505	4,525	4,545

FIGURE 2

EMERGENCY MEDICAL DRIVER[2]

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
National Estimate	21,288	21,373	21,461	21,549	21,637	21,729	21,818	21,906	21,995	22,087
Alternative 1	113,933	114,423	114,915	115,409	115,905	116,402	116,903	117,406	117,911	118,418
Alternative 2	21,288	21,373	21,461	21,549	21,637	21,729	21,818	21,906	21,995	22,087

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[1] National Association of Counties Research Foundation, *Safety Manpower Survey of Local Governments in the United States* (Washington, D.C.: National Association of Counties Research Foundation), p. E-7.

[2] *Ibid.*

FIGURE 3

EMERGENCY MEDICAL ATTENDENT[3]

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
National Estimate	19,575	19,668	19,753	19,838	19,923	20,008	20,093	20,178	20,263	20,348
Alternative 1	161,729	162,424	163,122	163,823	164,527	165,234	165,945	166,659	167,376	168,096
Alternative 2	19,575	19,668	19,753	19,838	19,923	20,008	20,093	20,178	20,263	20,348

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[3] *Ibid.*

B. OTHER BACKGROUND INFORMATION

Programs for training emergency medical services personnel are at various developmental stages in public educational institutions. A survey conducted by The Center for Vocational and Technical Education, The Ohio State University (1970) revealed several significant elements concerning emergency medical service training programs in community junior colleges. This information is delineated below.

1. NAME OF PROGRAMS

Seven programs in community junior colleges offer occupational education programs in emergency medical services. (This is not meant to suggest that these are the only programs in operation.) Three of these are "Emergency Medical Care." Others are entitled "Emergency Medical Technology," "Immediate Care of the Sick and Injured," and "Emergency Care."

2. TIME ALLOTTED FOR INSTRUCTION

All programs are less than one year in length--the longest, three months--the shortest, 18 hours.

3. STUDENT ENROLLMENTS

Student enrollments in emergency medical services programs range from 20 to 100. Six of the programs have less than 50 students enrolled.

4. PROGRAM ACCREDITATION

Three of the programs surveyed are accredited by state health departments; four are not; each presents certificates to graduates.

5. ENTRANCE REQUIREMENTS

There are no strict entrance requirements for students wishing to enroll in most of the programs. Only one requires a high school diploma, or the equivalent. Two specify that students should have studied first aid methods prior to enrolling.

6. STUDENT OPTIONS UPON COMPLETION OF THE PROGRAM

Since most emergency medical programs are of short duration, credits received are not transferable to other programs. Most instructional activities are in-service, and continue to be employed at the same place and after completion of the program.

7. INSTRUCTIONAL STAFF

Only one program reported employing a full-time instructor. Instruction is coordinated jointly by several persons within the educational institution and/or specialists are acquired on a part-time basis from outside the educational institution, e.g., physicians, fire chiefs, and police chiefs. There are no clearly prescribed educational and experience requirements for emergency medical services instructional staff in these programs.

8. METHOD OF SELECTING CURRICULA

Respondents to the survey indicated that methods used to select curriculum were divided equally between: 1) recommendations of local advisory committees, 2) analyses of local job tasks for essential knowledges and skills, 3) adoption of content from other training programs, and 4) analyses of community needs.

IV. PROGRAM CURRICULA

The U.S. Department of Transportation recently released three guidance documents and a final report concerned with the organization, administration, and management of training programs for emergency medical personnel. The publications are: 1) *Concepts and Recommendations*; 2) *Course Guide and Course Coordinator Orientation Program*; and 3) *Instructor's Lesson Plans*. It is recommended that training agencies and institutions carefully review these materials and consider the alternatives and possible adoption of the material for instructing emergency medical personnel, particularly in the medical aspects of training. This material is included as part of this unit.

Other selected publications reviewed and listed as "References" in the back of this unit, are for planning, conducting, and evaluating programs of instruction. Resource materials are listed in the bibliography.

V. CONCLUSIONS

A. Emergency medical services personnel may be called for anything from tornadoes and floods to childbirth, heart attacks and poisonings.

B. Many materials exist for use in planning and developing training programs in emergency medical services. Some of the most noteworthy being from the U.S. Department of Transportation.

C. There is a critical shortage of emergency services personnel in many communities.

D. Few public educational institutions train emergency medical personnel.

VI. DISCUSSION-RESEARCH TOPICS

It is the authors' hope that each of the following may be carefully considered as discussion-research topics by interested persons or groups.

A. Should specialists be trained to work full-time in highway emergency medical services? How much bearing does the size of the community have with what emergency medical personnel are required to know and be able to do? What are the unique requirements of emergency medical personnel in rural communities?

B. What private and/or governmental agencies employ highway emergency medical personnel?

C. Should ambulance drivers and ambulance attendants be equally responsible in emergency situations? If not, what medically-related tasks does the ambulance driver need to be able to perform?

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Life in Your Hands. (12 min.) black and white. Chicago, Illinois: American Medical Association Motion Picture Library, 535 North Dearborn Street.

Resuscitative Care of the Severely Wounded. (24 min.) color. Chicago, Illinois: Motion Pictures Library, American College of Surgeons, 55 East Erie Street.

HIGHWAY DESIGN, CONSTRUCTION, AND MAINTENANCE

I. INTRODUCTION

"Accidents don't just happen--they are caused." This statement, when related to highway safety, is interpreted by the general public to pertain to the human factor in traffic accidents. But, other factors are involved in highway safety, including the design, construction, and maintenance aspects of highways and streets. A safe driving and walking environment should be of primary concern to personnel who are responsible for creating and maintaining streets and highways at all employment levels.

Hyer (1970) states that approximately $320 billion should be spent over the next 15 years on additional highway improvements if the United States hopes to meet the nation's increasing demand for highway transportation services. The average annual expenditure for highways over the next 15 years will have to be approximately $21 billion compared to an estimated $11.5 billion that will be spent this year (David C. Hyer, quoted in *Columbus* (Ohio) *Dispatch*, September 22, 1970).

From the beginning of the Federal-Aid Highway Program, which actually began with the Federal-Aid Road Act of 1916, highway safety has been a major concern. Most major highway projects contribute to increased highway safety. But, highways must accommodate increasing numbers of motor vehicles, drivers, and passengers. The number of accidents and resulting fatalities, injuries, and property damage continue at an alarming rate because: 1) more people are traveling by highways and are traveling greater distances; and 2) there are certain highway condition hazards. An efficient and effective highway improvement program must be multifaceted and must be applied throughout the planning, location, design, construction, and maintenance stages of the highway developmental process (*Report on the Status of the Federal-Aid Highway Program*, Hearing Before the Subcommittee on Roads of the Committee on Public Works, United States Senate, April 15, 1970, p. 131).

Highway safety factors to consider in relation to design, construction, and maintenance include among others: 1) hazardous intersections (geometric features); 2) potential dangers of fixed devices such as guard rails; 3) widths of streets and highways to accommodate traffic loads; 4) roadway shoulder; 5) bridge widths; 6) obstructions to traffic such as trees, signs, and utility lines; 7) roadway medians; 8) placement of signs; and 9) street and highway lighting.

The Department of Transportation specifies that:

> every state in cooperation with county and local governments shall have a program of highway design, construction, and maintenance to improve highway safety . . . to assure: a) that existing streets and highways are maintained in a condition that promotes safety, b) that capital improvements either to modernize existing roads or to provide new facilities meet approved safety standards, and c) that appropriate precautions are taken to protect passing motorists as well as highway workers from accident involvement at highway construction sites.[1]

The magnitude of the existing highway and street system in the United States is a cause for amazement and wonder. Construction contracts involving 236,256 miles of primary and secondary highways and their urban extensions were completed between July 1956 and April 1970, at a cost of $20.95 billion. Another 13,846 miles are under construction at a cost of $3.73 billion. The primary-secondary-urban program of highway construction is financed by the federal government and the states on an equal-share basis. Since 1956 nearly $67 billion of taxpayers' funds have been invested by federal and state agencies on Federal-Aid system improvements. Almost 30,000 miles of the 42,500 mile National System of Interstate and Defense Highways are now open to traffic, and construction is underway on another 4,782 miles (*Report on the Status of the Federal-Aid Highway Program*, United States Senate, April 15, 1970, pp. 3-6).

As a result of these programs, safety specialists are needed in planning, developing, maintaining, and evaluating highway and street systems to insure that the risk of accidents and resulting deaths, injuries and property damages are kept at a minimum. There is also a great need for more technically qualified personnel to assist in the development and application of engineering science in the design, construction, and maintenance of the highway transportation system.

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[1] U.S. Department of Transportation, National Highway Safety Bureau, *Highway Design, Construction, and Maintenance: Highway Safety Program Standard 12*, June 1967.

II. IDENTIFICATION AND CLASSIFICATION OF PROGRAMS AND OCCUPATIONS

The technician in highway design, construction, and maintenance is frequently employed in direct support of the professional engineer, architect, economist, or city planner. The technician is usually required to perform duties that require background knowledges in science and supportive mathematics, as well as methods, skills, materials and processes commonly used in the services performed in the design, construction, and maintenance process. The technician is heavily involved, in a supportive role, in the complex and sophisticated planning and design decisions and applications that have far-reaching significance in terms of the safety of motor vehicle drivers, passengers, and pedestrians who ultimately use the system.

Although numerous skilled personnel (craftsmen and laborers, or helpers) are involved in highway design, construction, and maintenance activities, they are not considered to be directly engaged in unique highway safety activities. The exceptions to this rule would be the maintenance foreman and the construction foreman who are responsible for inspecting the performance of crews in regard to the safety of their work, and to assure that specifications drawn up by the engineers and technicians are properly incorporated into the finished work. The maintenance foreman and the construction foreman will be considered as highway safety occupations, but reported only since they are associated with duties as a highway safety site officer. The highway safety site officer is one of the targeted occupations to be discussed later in this report.

Highway safety titles for the design, construction, and maintenance occupations are identifiable, and the duties and responsibilities of some of these occupations can be clearly described. However, many of the occupations do not encompass unique aspects of highway safety. The following analysis will illustrate the range of occupational titles. This analysis will also show the link between the state and local governments, and services which relate to highway safety in regard to design, construction, and maintenance occupations. Also shown are the agencies responsible for identifying and classifying occupations for guidance, training, and placement purposes.

TITLE VARIATIONS	U.S. OFFICE OF EDUCATION PROGRAM CLASSIFICATION	D.O.T. CLASSIFICATION
Traffic Engineering Aide	16.016 Civil Technology	249.288-018 Map Editor
Civil Engineering Aide		249.587-010 Note-Keeper

TITLE VARIATIONS	U.S. OFFICE OF EDUCATION PROGRAM CLASSIFICATION	D.O.T. CLASSIFICATION
Design Engineering Aide	16.010601 Roadway Tech	005.281-010 Highway Designer
Transportation Safety Engineering Aide		
Investigations Technician		
Highway Safety Supervisor		
Engineering Assistant		
Engineering Aide		
Highway Technician		
Engineering Associate		
Employee Safety Specialist		
Laboratory Technician		

Other employment titles that are found in local and state governmental and private agencies are listed in the *Dictionary of Occupational Titles* and perhaps should be considered as possible targets for occupational training. These include the highway surveyor helper, and the highway construction worker foreman. However, a line must be drawn at some point to distinguish between those occupations that are direct highway safety occupations, and those which involve an insignificant degree of highway safety related activities. The craft occupations, such as the "rough" carpenters on a road crew, perhaps cannot be characterized as highway safety occupations due to the relatively small amount of time spent in direct highway safety work. However, this report takes an open-ended approach, and further insights during the course of the project might have direct bearing on the justification of further work and study in some of the areas in question. Also, new and emerging occupations may come to light before termination of this project and will be given due consideration for the planning and development of training activities in the various agencies and institutions.

The U.S. Office of Education's program classifications were drawn from *Vocational Education and Occupations*, a code manual developed as the official guide for use in establishing vocational and technical programs. The program titles, as well as the specified subject contents given in the manual, were developed from existing state vocational and technical reports, available curriculum materials, and through conferences with vocational education personnel among the states. The design of the manual is strongly oriented toward the *Dictionary of Occupational Titles*. New and emerging occupations are not considered as such, but provisions are made for including these in a category entitled "Other Miscellaneous Technical Education" or "Other Trade and Industrial Occupations."

There is some question as to whether the traffic engineering specialist or technician should be included in the highway design, construction, and maintenance category or in the traffic control device category to be developed as a separate entity. A superficial review of training materials in traffic engineering technology indicates that the traffic engineering technician is generally heavily involved in the planning and application of highway and street signing, traffic signaling developments. It is rather vague, from this writer's standpoint, as to whether the traffic engineering technician spends more time in the planning and development of traffic control devices or whether he is more heavily involved in the planning phase of highway design, construction, and maintenance. It is hoped that the review and synthesis of materials and the ensuing workshops will bring these facts to the surface.

III. GENERAL PROGRAM BACKGROUND AND CONSIDERATIONS

Recent research and new technological developments have been quite far-reaching in terms of the design, construction, and maintenance of streets and highways. The federal government has had an important role in setting primary design standards and construction specifications to improve the roads and streets. The federal government's requirement that these standards be met by those responsible for the planning, designing, construction, and maintenance of streets and highways have had far-reaching implications for planning, organizing, and developing programs of instruction for technical training.

Superimposed upon the research developments and subsequent federal agency concern for highway safety is the compounded rate at which highways must be improved and new systems developed to accommodate the increasing flow of traffic in and around urban areas and in other concentrated traffic situations.

As new materials, methods, concepts, and techniques that have application to many design, structural, and maintenance aspects of streets and highways are introduced, it becomes increasingly important to have more skilled and knowledgeable people to perform the required duties and responsibilities for implementing highway safety programs. For example, electronic distance-measuring devices are being used in survey work that contribute to better constructed and safer highways. Electronic computers, another innovation, are being used in drafting operations that speed up the process of designing structures and result in greater accuracy in drafting operations.

The significance of the highway safety role of design, construction, and maintenance personnel can be further stressed. Design personnel must be certain that working drawings and specifications conform to federal standards and requirements. Construction personnel must be certain that geometric designs are closely followed. Maintenance personnel must be certain that dangerous objects are removed or replaced in such a manner as to be safe to oncoming traffic.

More appropriate and stronger measures must be taken in all highway design and construction activities to insure that the highways and streets are as safe as possible. Much of this assurance can come through the performance of well-trained personnel who can insure that features likely to contribute to the cause or severity of accidents are eliminated or minimized to the extent practical. An effective detection and correction program must be based on thorough analysis of accident occurrence and causal factors. This also involves actual accident experience analysis, traffic characteristics, and highway locations, geometric features, route sections, etc. (*Report on the Status of the Federal-Aid Highway Program*, U.S. Senate, April 15, 1970).

A. OCCUPATIONAL TARGETS OF THE HIGHWAY DESIGN, CONSTRUCTION, AND MAINTENANCE PROGRAM

The highway design, construction, and maintenance program is aimed at several skill and responsibility levels. Both preparatory, or preservice, and in-service training should be ultimately considered in program implementation and development. The highway safety elements encompassed by highway design, construction, and maintenance operations are rather difficult to identify. For example, how much would a highway engineering aide feel that he was directly concerned with the state or national program for highway safety? He may not relate any of his activities to highway safety, particularly if his primary duties are revising or tracing working drawings and indexing. However, if he is heavily involved in the planning process or in developing construction specifications the work would be heavily oriented toward highway safety. Other workers such as heavy equipment operators, would probably not be oriented to highway safety functions.

An intensive effort has been made to identify existing programs and courses which have a significant degree of relevancy to highway safety, and to determine the technical content of their instructional activities by reviewing, analyzing, and synthesizing training materials and resources. Also, new and emerging occupations in the highway design, construction, and maintenance functions have been explored. Regardless of these efforts, there is still some question as to how much highway safety is involved in some of these occupational programs. However, it seems appropriate to say, at this point, that the occupational target of the highway design, construction, and maintenance training programs should be at the technical, para-technical and supervisory levels.

Several titles that relate to the design, construction, and maintenance area were listed at the outset of this study. The titles vary, to some extent, from agency to agency and from state to state. Also, the duties and responsibilities required of personnel in these positions are somewhat inconsistent among the various employment agencies. This being the case, there is lack of a high degree of standardization of instructional activities provided through the various community-junior colleges across the nation. This problem will be taken up in more detail throughout the course of this report.

Several job titles, along with the educational and training requirements and employment levels are given in Table I. The table projects a more perspective view of the highway design, construction, and maintenance industry. Perhaps the level at which the highway safety elements come into focus can be visualized.

TABLE I

HIGHWAY DESIGN, CONSTRUCTION, AND MAINTENANCE JOB TITLES AND EDUCATIONAL REQUIREMENTS

(Possible Alternatives to Career Choices and Career Ladders)

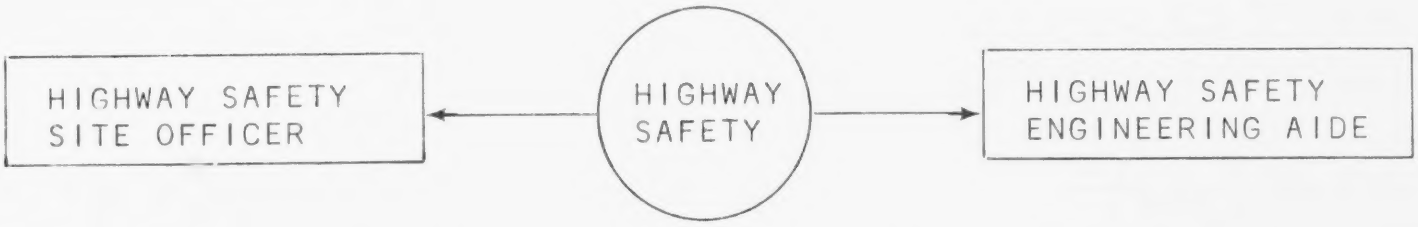
Job Titles	Educational and Training Requirement	Occupational Level
Urban Planner	Ph.D. Degree	Hyper-Professional
Highway Engineer	B.S., M.S.	Professional
Engineering Technician	Associate Degree	Semiprofessional
Construction Foreman	Certificate	Skilled
Machine Operator	Apprenticeship Program	Semiskilled
Laborer	NONE	Unskilled

Although this study is primarily concerned with training programs at the associate degree level and below, higher degree levels are shown in Table II to emphasize the overall picture of highway design, construction, and maintenance. Career ladders may be inherent among the various positions shown, but workers would not be likely to move "up the ladder" through experience alone. Further education would be necessary to enter each occupation higher on the ladder.

Table II illustrates the principal occupational targets of the highway design, construction, and maintenance program. Entrance into the position of a highway safety site officer may entail several years of experience (or the equivalent in training) in the highway construction field. In-service training for construction supervisors and foremen may be the key to preparing personnel for this occupation. Entrance into the position as an engineering aide could be accomplished through a preparatory type program at the post-secondary level. Numerous programs exist, such as highway technology, in the community-junior colleges that prepare personnel for much of the knowledge and skills required as highway engineering aides.

TABLE II

HIGHWAY DESIGN, CONSTRUCTION, AND MAINTENANCE OCCUPATIONAL TARGETS



Note: These occupations require less than a B.S. degree for entry. Currently, work experience may be required for entering the position of highway safety site officer.

Programs for training engineering aides may be of the certificate or associate degree type. The certificate program would perhaps be one year or less in duration, while the associate degree program would be for two years. There has been some recent emphasis in providing intermediate level training for specialists who would be employed in an occupational field between the craftsmen and the engineer, but in the area closer to the craftsman. Personnel completing these programs may be employed as materials laboratory technicians, or in construction projects assisting in supervision under the direction of the civil engineer. The certificate program may provide adequate training for these positions (Dobrovolny, 1968). There is a great deal of similarity between the associate degree programs and the certificate programs. The certificate program places more emphasis on the technical specialities and technical skills that are directly applicable to fewer targeted positions. Such a program may be appropriate for preparing personnel for positions as safety site officers.

Many highway workers are currently employed as highway engineering aides. Many of these are finding it difficult to advance to higher positions of skill and responsibility because of lack of existing training opportunities. Therefore, the community-junior colleges can do much in offering programs in these areas of upgrading workers currently employed in the field.

It is not the intention of this project to completely "count out" such occupations as the surveyor's aide, highway construction craftsman, and others who are involved in the construction and maintenance of streets and highways. If it is deemed that others are involved with unique safety aspects, and potential employers or employees need instruction in applications of highway safety, programs or courses are certainly justifiable.

B. OCCUPATIONAL SUMMARIES

The skills and responsibility requirements of the two targeted occupations shown in Table II will be briefly summarized to provide a departure point for further exploration of the subject content and other program information. It is assumed that these are the more important occupations in terms of existing and projected manpower specialists needed in implementing the National Highway Safety Program.

1. HIGHWAY SAFETY SITE OFFICER

A portion of *Highway Design, Construction, and Maintenance: Highway Safety Program Standard 12* indicates that the states are to "insure that appropriate precautions are taken to protect passing motorists as well as highway workers from accident involvement at highway construction sites."[2] The primary role of the safety site officer is to provide appropriate guidance and supervision at highway construction and maintenance sites to insure that safety precautionary measures are applied by responsible parties. The duties would include the following: providing technical assistance and supervision in the elimination of, or modification of, hazardous working conditions, equipment or materials; supervising a program for guidance, warning and regulating approaching traffic, and traveling over construction or repair sites and detours; investigating accidents to determine causal factors and recommending remedial measures; inspecting construction and maintenance work on highways and streets to determine and enforce compliance with department safety requirements; and disseminating and reviewing educational materials (Booz-Allen and Hamilton, Inc., Vol. 1, Appendix B, 1968; National Highway Safety Bureau, 1967).

It is assumed that a person could presently find employment in this position with the proper educational experience background in highway construction and maintenance. It seems feasible that appropriate preparatory experiences can be conducted by public post-secondary educational institutions.

2. HIGHWAY SAFETY ENGINEERING AIDE

There are numerous highway and street design and construction safety standards followed by those concerned with the designing, planning and modification of existing facilities, or in developing new systems. These standards, which are issued or endorsed by the Federal Highway Administration, concern sight distances, horizontal and vertical curvatures, width of lanes, high skid resistance of pavements, structure of guard rails, etc. The standards are of primary concern to the highway safety engineering aide who performs various technical tasks under the supervision and direction of the highway design engineer or the highway engineer. The tasks delineated below represent a synthesis of the job descriptions for the engineering aide and the design technician, which were based upon a survey of county, city and township employment by the National Association of Counties (1970).

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[2] U.S. Department of Transportation, National Highway Safety Bureau, *Highway Design, Construction, and Maintenance: Highway Safety Program Standard 12*, June 1967.

> Making calculations in checking and simplifying field survey notes; making topographical calculations; drafting detailed construction drawings; drafting topographical profiles and related maps and specifications used in highway construction; tracing working drawings; assisting in surveying topographical areas for highway construction projects; inspecting construction work and materials used in construction projects.[3]

Other duties of the highway safety engineering aide may include: assisting in field surveys of road conditions, including traffic studies to determine the adequacy of streets and highway systems; assisting in community planning projects which impact on pedestrian and motorist safety; and assisting in road inventories (lengths, widths, etc.).

Highway safety engineering aides sometimes specialize in certain specific activities. For example, personnel may be involved primarily in taking inventory of streets and highways using new electronic distance-measuring devices to acquire accurate measurements of lengths and widths.

It will be assumed that an individual would find it extremely difficult to enter this occupation without prior experience or appropriate technical training. Also, it will be assumed that a person would need periodic in-service training in order to stay abreast of the new developments in highway design, construction, and maintenance, as well as the National Highway Safety Program.

C. MANPOWER PRESENTLY EMPLOYED AND FORECASTS OF MANPOWER NEEDS

A survey conducted by the Institute of Traffic Engineers (1963) found a shortage of over 1,400 traffic engineers in the United States. At that time there were 7,000 traffic engineers employed. Traffic problems have rapidly increased since then, and the demand for highway traffic engineers has also increased. It is assumed that there is a severe shortage of highway engineering aides since they have proven to be valuable support personnel to the professional engineers. Koert (1969) reports that the shortage for traffic engineer technicians is even more critical since relatively few occupational training programs exist for traffic engineers. Koert states that . . . "Engineers hire whatever personnel they can obtain and attempt to bridge the educational deficiencies with in-service training."[4]

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[3] National Association of Counties, *Manpower Survey of Local Governments in the United States*, 1970, pp. B46, B55.

As early as 1956 the United States was deeply concerned about the shortage of scientific manpower, including technicians. At that time a Committee on Scientists and Engineers was appointed by the President of the United States to study the shortage of technicians. The Commission's final report to the President (1958) concluded with the statement ". . . the manpower problems for technicians are at least as severe as that of the scientists and engineers."[5]

The Engineering Manpower Commission (1956) reported that there will be a 133 percent increase in the demand for civil engineering technicians in transportation during the period of 1965-1976 (as quoted in *Civil Engineering Technology Consultants' Workshop*). This same report indicates that there would be a 58 percent increase in the demand for civil engineering technicians in construction activities for the same period. This is in spite of the stable situation for the demand for civil engineers for the construction industry. Also, it was estimated that there would be a 27 percent increase in demand for civil engineering technicians at the local government level and a 22 percent increase in demand for civil engineering technicians at the state government level. All figures were based upon the generally accepted figure of three technicians for each practicing professional engineer (American Association of Junior Colleges, 1967).

Booz-Allen and Hamilton, Inc., in 1968, reported an immediate maximum need for 3,308 highway safety site officers at state level jobs to implement a comprehensive safety site program. When viewed over a 10 year period, the figures given by Booz-Allen and Hamilton represent an average annual need for 374 highway safety site specialists at the state level. These figures were based upon the assumption that one officer is needed at headquarters, one officer per county, and one level of supervision with one supervisor per 10 subordinates.

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[4] Adrian H. Koert, *Traffic Engineering Technician Programs in the Community College*, 1969, p. 2.

[5] American Association of Junior Colleges, *Civil Engineering Technology Consultants' Workshop*, 1967, pp. 12-13.

D. PRESENT NUMBER OF STUDENTS ENROLLED IN PROGRAMS AND COURSES

According to the instructional program enrollment summary compiled by the U.S. Office of Education, a grand total of 13,885 students were enrolled in civil technology programs in public educational institutions across the nation during the fiscal year 1969. These figures include preparatory and supplementary training. Table III gives a breakdown of the enrollment figures by program types and by people groups. No training activities were found to be in existence or were planned for highway safety site officers at the time of this writing.

TABLE III

VOCATIONAL EDUCATION ENROLLMENTS FISCAL YEAR 1969*

TECHNICAL OCCUPATIONS

D.E. Code Number and Program Title

16 0106 Civil Technology

Grand Total	13,885	Male 13,689	Female 196
Secondary	550		
Post-Secondary	7,501		
Post-Secondary Cooperative	333		
Adult Preparatory	756		
Adult Supplementary	4,502		
Apprenticeship	12		
Special Needs	184		

Note: The majority (171) of the enrollees classed as special needs subjects are actually enrolled in regular classes.

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*U.S. Office of Education, Planning and Evaluation Branch, 1970.

Community-junior college highway design, construction, and maintenance related programs and courses show a wide diversity of titles. Forty-seven deans of instruction and program chairmen responded to the survey of community-junior college highway design, construction, and maintenance related training activities conducted by The Center for Vocational and Technical Education, The Ohio State University. Although many programs and course titles suggest commonalities, there were 11 program titles shown to be in existence. However, 67 percent of the respondents showed their programs to be entitled "Civil Technology." Other program titles included: Highway Technology; Civil Engineering Technology; Surveying Technology; Highway Construction Technology; Drafting and Design Technology; Concrete and Aggregate Technology; Civil Construction Technology; Engineering Technology; and Urban Planning Technology. These are shown by order of reported frequency. It is assumed that the aforementioned student enrollment figures for civil technology programs are inclusive of all these programs with similar characteristics.

The survey conducted by The Center showed 1,897 students enrolled in the 47 programs. The largest enrollment given for any program was 308. The smallest enrollment figure given for a program was six. Median range enrollment for programs was approximately 35.

E. STUDENT RECRUITMENT

It should be pointed out that most of the materials and resources compiled relate to only one of the targeted occupations--highway safety engineering aide. Therefore, most of the information gathered on student recruitment will relate to the programs of instruction for engineering aides. However, some general remarks can be made concerning student recruitment for training programs in highway safety site work. Such programs will likely have to recruit students who are presently employed in highway construction or related work and prepare them for roles as safety site officers. Perhaps it is feasible that programs can be developed to train people without previous experience. Work experience could be added to the curricula. The approach to take in training people for this occupation and recruiting students should be decided by those more closely associated with the highway safety program and the highway construction project work.

The forty-seven deans of instruction and program chairmen participating in the survey were asked to describe their schools' student recruiting efforts in terms of the following rating scale: more than adequate; adequate; slightly inadequate; and very inadequate. The results were as follows: more than adequate, 16 percent; adequate, 34 percent; slightly inadequate, 34 percent; very inadequate, 15 percent. Forty-four responded to this inquiry. The percentages represent the total number responding to each item.

Although 50 percent of the respondents indicated that their schools' recruiting efforts were more than adequate, an equal number indicated that their efforts left something to be desired. This may be due in part to the necessary entrance requirements for some of the programs. For example, the highway technology program, by necessity, involves considerable mathematics and physical science. The curriculum is intended for high school graduates who have particular abilities and interests. The strong educational requirements of the programs that relate to the highway engineering aide may prevent some students from enrolling in these instructional activities.

Recruiting efforts could be enhanced if the curriculum allowed for training at more than one technical level. The range of positions between the craftsman and the highway engineer is broad enough to accommodate several levels of trained technicians or specialists, including the highway safety engineering aide.

F. PREREQUISITES FOR STUDENTS ENTERING PROGRAMS AND COURSES

The survey of program chairmen and deans of instruction did not reveal extraordinary restrictions on students enrolling in programs in highway design, construction, and maintenance. However, most (85 percent) of the community-junior colleges require that students enrolling in programs of instruction in highway design, construction, and maintenance have a high school diploma or the equivalent. Based upon the survey, the other most common requirements are: students must have passed the Scholastic Aptitude Test; students must meet certain physical requirements; and students must have passed the General Aptitude Testing Battery. Two programs did not indicate restrictions on students entering the programs of instruction.

Admission requirements should be based upon the instructional level of the program. If the program is to prepare personnel for positions directly in support of the highway engineer, then, the guidance, testing and program placement process should focus upon the specific student abilities, aptitudes and interests deemed vital to success in the curriculum and subsequently on the job. The same would be true for the intermediate and para-technical levels.

Some post-secondary schools have recently introduced pre-technical programs for students who lack the scholastic requirements for entering a technical program. In such programs, students are introduced to study skills, preparatory communication skills and preparatory mathematics and science knowledges and skills. They are also provided occupational orientation in several technical fields. The programs vary from several weeks to a full semester in length (U.S. Office of Education, 1967).

It is very difficult to determine at this point what the student requirements should be for entering programs of instruction for highway safety site officers. The occupation is not defined to the extent that this is possible. The brief job descriptions which are available for the highway safety site officer suggest that persons entering the occupation have at least three years of experience or the equivalent as a foreman or a supervisor in highway construction and maintenance work. It is assumed that it is possible for a person to gain the necessary educational and occupational experience requirements through an occupational education program. However, the survey did not reveal any existing programs of this nature. An occupational analysis is needed for this particular occupation before conclusions can be drawn and recommendations made as to the student prerequisites for entering occupational training.

The prerequisites for the highway engineering aide program can be more clearly defined. The prerequisites mentioned above in the survey information closely relate to the common prerequisites of a program for highway engineering aides. It would be necessary that student enrollees have completed some algebra, geometry, and physical sciences, preferably physics.

The use of a standardized test would assist in guidance and selection of students for programs of instruction. More concrete prerequisites can be established after the primary functions of the engineering aide are identified, particularly those functions that relate to the unique safety aspects of design, construction, and maintenance of highways. However, much can be drawn from existing programs in civil technology, highway technology, etc.

G. RELATION OF PROGRAMS TO NATIONAL AND STATE SAFETY GOALS AND OBJECTIVES

The survey instruments sent to the deans of instruction and the program chairmen made provisions for the respondents to indicate to what extent they felt the schools' programs or courses identified with or related to the national and state programs in highway safety. Each respondent was given an opportunity to rate their program according to the following scale: great extent; moderate extent; some extent; no extent; and I don't know. The total number of responses to each item were determined and recorded according to percentages. The results were as follows: great extent, seven percent; moderate extent, 27 percent; some extent, 36 percent; no extent, seven percent; I don't know, 23 percent.

Again, it must be emphasized that this data has direct relationship with the highway engineering aide rather than the highway safety construction site officer. It is significant to note that 23 percent did not know whether their programs or courses identified with or related to the national and state programs in highway safety. This may stem from the fact that some programs, such as civil technology and drafting and designing technology, are not as closely related to highway design, construction, and maintenance. Therefore, Highway Safety Standards and specifications may not have permeated or influenced these types of programs. Also of significance is the relatively small percentage of the programs that were shown to be identified with or related to the national and state programs in highway safety to a great extent.

H. EXTENT GRADUATES CONTINUE TO WORK IN THEIR FIELD OF TRAINING

In the past, technical programs that relate to highway design, construction, and maintenance have prepared students for employment in a number of occupations. For example, the civil technology programs have attempted to prepare students to enter occupations as surveyors, construction site inspectors, soils testers, and highway designers. Historically there has not been a high order of specialization. Therefore, the curricula used in programs of instruction have been rather broad based.

The majority (56 percent) of the respondents to the survey conducted by The Center for Vocational and Technical Education, The Ohio State University, indicated that their graduates continued to work in the field for which the training has prepared them to a great extent. This was based upon the following choices of responses: great extent; moderate extent; some extent; no extent; and I don't know. Twenty-three percent of the useable returned instruments showed course graduates continued to work in the field for which the training has prepared them to a moderate extent. The remainder (21 percent) indicated that they did not know to what extent their program or course graduates continued to work in the fields for which the training has prepared them.

Although most of the schools indicated that students continued to work, to a great extent, in the field for which they were trained, insufficient evidence exists to conclude that the curriculum content of programs is compatible with the employment needs. For example, the student successfully completing program requirements may have been employed at an advanced level but could continue to maintain this status only after immediate on-the-job training.

The percentages acquired from the survey do not necessarily indicate that the majority of students continue to work in the field for which training has been given. Also, a relatively high percentage indicated that the employment status of the student was unknown.

I. STAFFING AND STAFF REQUIREMENTS

The ultimate effectiveness of the curriculum in highway design, construction, and maintenance depends heavily upon the quality of the instructor. Generally, the teachers are required to have special competencies based on proficiency in technical subject matter and industrial experience. Most (60 percent) of the schools surveyed indicated that their highway construction, design, and maintenance instructional staff were required to have an M.S. or B.S. degree in the related field of study, plus at least two years of experience in the occupation for which they will instruct. Twenty-one percent indicated that an M.S. or B.S. degree was required in the related field of study and experience was not a factor. Also, approximately 19 percent require experience in related field only.

The survey did not reveal a great deal of specialized technical short-term programs or courses related to unique aspects of highway safety. It is assumed that teachers of specialized subjects in the area would be required to have advanced training and/or experience.

Many of the attributes desired of other college teachers are applicable to the staffs for highway safety engineering aide programs and highway safety site officer programs. They should be carefully selected upon the basis of their previous experience. It is suggested by many that instructors in civil and highway technology programs should be required to have at least a bachelor's degree in civil engineering. However, there has been increased emphasis to hire engineering technicians on a part-time or full-time basis. This seems ideal because of the shortage of available professional engineers for teaching positions, and the technician, by virtue of his experience, may be able to positively relate to realistic employment needs.

It is assumed that the instructional staff for a program to train highway safety site officers would have to be selected from the field of work--construction and maintenance of highways. It would appear difficult to acquire personnel with a B.S. degree.

Interagency cooperation is a vital factor in the success of highway safety engineering aide programs and highway safety site officer programs. Department chairmen should be adept in working closely with advisory groups composed of representatives from firms which employ program graduates. These advisory groups can assist the instructor in identifying curriculum content, placing graduates and maintaining technical competence in the field.

J. TYPE DEGREES GIVEN FOR COMPLETION OF PROGRAM

The survey of community-junior college programs revealed that 85 percent of the programs related to highway design, construction, and maintenance offered an associate degree. The remainder of the programs provided a certificate. Generally, the certificate programs are less than one year in length.

K. STUDENT OPTIONS UPON COMPLETING INDIVIDUAL PROGRAMS AND COURSES

Some of the technology programs that relate to highway construction, design, and maintenance allow for one or more student options. For example, a student in civil technology might have an option between highway and structural technology. Traffic engineering technology programs may provide for options in urban planning, traffic control device technician, and specialization within the field of civil engineering work after the first year of study.

The survey revealed that students have several other options in existing programs. For example, students may transfer to four-year degree programs with credit acknowledged for their completion of a previous program. These requirements have particular relationship to the programs rather than courses within programs. The survey revealed few individual training courses for highway design, construction, and maintenance personnel.

L. AGENCIES EMPLOYING GRADUATES

Based on the findings of the survey conducted by The Center, the three most common agencies employing graduates from programs related to highway design, construction, and maintenance were: 1) state highway departments, 2) city governments, 3) county governments, and 4) private companies. Other agencies employing graduates included public schools, architects and engineers, construction firms, consulting engineers, and federal agencies.

M. NATURE OF INSTRUCTIONAL ACTIVITIES

The survey revealed that most of the instructional activities were of the two-year associate degree type program. The courses found in existence were part or a segment of the total program. No specialized individual short courses or conference-workshop type instructional activities were revealed in the survey.

The classroom lecture was given as the most common method of instruction. However, the respondents indicated that their instructional activities included a mix of simulated classroom and laboratory type activities as well as planned field activities. Also, cooperative or part-time on-the-job experiences are sometimes given along with the classroom instruction.

N. FACILITIES, EQUIPMENT AND SUPPLIES INFORMATION

Local schools planning the establishment or the expansion of highway design, construction, and maintenance training activities should begin with an accurate picture of the community training needs and requirements. An open channel of communication must be established between education and the highway safety industry. An advisory committee, which is a composition of selected persons from a specific occupational area, can make recommendations concerning facilities, equipment and supplies for instructional programs. The assistance of the advisory committee can be invaluable in the planning, construction, and operation of training programs.

A curriculum guide entitled *Civil Technology: Highway and Structural Options* was developed in 1966 by technical education specialists in the Occupations Sections, Division of Vocational and Technical Education, the U.S. Office of Education. This material includes information on facilities and equipment and the cost of such facilities and equipment. Included are principles to be applied in planning facilities in highway instructional technology, types of laboratories needed, basic laboratory equipment and supplies, a list of laboratory equipment and supplies with estimated costs, and laboratory layouts. This source is listed in the bibliography of this section. Another possible source for planning and equipping laboratories is entitled *Planning and Equipping School Shops for Trade and Industrial Education*. This material was prepared by the Curriculum Coordinating Unit, Division of Vocational and Technical Education, State Department of Education, Jackson, Mississippi (1969). Basic principles for establishing shops are presented along with shop layouts for 19 occupational areas. It does not include shop layouts for the targeted occupational areas discussed in this report.

Respondents to the survey of highway design, construction, and maintenance programs in community-junior colleges indicated that commercial publishers were the primary source of program and course guides and reference materials. This was closely followed by trade associations and societies as a primary source of materials. Vocational-technical curriculum materials centers in states and centers in other states were not given as a primary source of materials.

IV. PROGRAM CURRICULA

This report will give an overview of some quality standards proposed by such groups as the American Association of Junior Colleges and the American Society for Engineering Education for planning, developing and implementing engineering technology curricula. Several curricula patterns and curricula will be presented, along with exemplary curricula outlines. Most of the information will be related to civil and highway technology, since most of the materials accumulated for this project were training materials and resources used in these programs. However, it is hoped that the exemplary materials will also have a direct relationship to training programs for highway safety engineering aides, particularly in the planning and development of curricula. It is assumed that there is a moderate degree of parallel between technical programs in general and more specifically between programs in civil technology, highway technology, highway safety engineering technology, etc.

Unfortunately, only a few training materials for highway safety site officers were found to be in existence. Perhaps additional materials will be discovered during the course of this project to strengthen the base for planning and developing curricula in this area.

A. PROGRAM SUBJECT ELEMENTS

Most of the existing curricula that relate to training programs in highway design, construction, and maintenance are designed for two-year, associate degree type programs in community-junior colleges and technical institutes. Usually, there are some commonalities in the following essential subject elements included in the materials: 1) basic science courses, 2) nontechnical courses, and 3) technical courses. The most diverse aspects of curricula are in program titles and in the occupational targets of the programs. Most curricula is confusing because of a lack of explicit performance goals. The three most common highway technical programs are civil and highway technology, highway engineering technology, and traffic engineering technology. Yet, there appears to be much overlapping of subject content from one program to the next.

1. CIVIL AND HIGHWAY ENGINEERING TECHNOLOGY

There have been several studies made to determine what major subject elements should be incorporated into civil technology curricula and the time that should be allotted to each element.

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Table IV was developed by Dobrovolny (1968) and reflects the guidelines of two previous studies: 1) *Characteristics of Excellence in Engineering Technology Education*, prepared by the American Society for Engineering Education (1962); and 2) *Occupational Criteria and Preparatory Curriculum Patterns in Technical Education Programs*, prepared by the U.S. Department of Health, Education and Welfare, Office of Education (1962).

The U.S. Department of Health, Education and Welfare, Office of Education (1966) prepared a curriculum guide for *Civil Technology: Highway and Structural Options*. It is designed to assist administrators, supervisors, and teachers to plan, develop and evaluate programs. The guide is comprised of course outlines, suggested operational procedures, laboratory layouts, texts and references, list of laboratory equipment and its costs and a selected list of scientific and technical societies. The guide will be helpful in developing a program to train highway safety engineering aides. An overview of the suggested curriculum appearing in the publication is shown in Table V and Table VI. The highway and structural options are shown. Particular attention should be given to the highway option.

2. TRAFFIC ENGINEERING TECHNOLOGY

Generally, the traffic engineering aide and the highway engineering aide are considered to be two separate and distinct occupational areas. The traffic engineering aide works closely with the traffic engineer in traffic planning and traffic design. On the other hand, the highway engineer aide works closely with the highway engineer in construction and maintenance projects. There are commonalities in field duties and responsibilities of the traffic engineering aide and the highway engineering aide. Both will be considered in this report. Perhaps the unique highway safety aspects of both will be revealed.

The American Association of Junior Colleges recently published a guide for *Traffic Engineering Technician Programs in the Community College*, which was authored by Koert (1969). In this publication, work and educational requirements of the traffic engineering technician were outlined.

> The traffic engineering technician is concerned with more repetitive tasks involving data collection, the analysis of data, and the preparation of tentative recommendations for the correction of problem locations in the roadway system. Specific tasks to be performed include the following:
>
> 1. Surveillance of existing traffic
> 2. Study of problem locations

TABLE IV

ENGINEERING TECHNOLOGY EDUCATION CURRICULUM SUMMARY IN CREDIT HOURS*

CURRICULUM SUBJECT ELEMENTS	CREDIT HOURS
Basic Science Course	
Mathematics	10
Physical Sciences	9
	19
Nontechnical Courses	
Communications	6
Humanistic-Social Studies	9
	15
Technical Courses	
Technical Skills	6
Technical Specialities	32
	38
TOTAL CREDIT HOURS	72

*Jerry S. Dobrovolny, *Civil Engineering Technology Consultants' Workshop*, 1968, p. 19.

TABLE V

CIVIL ENGINEERING TECHNOLOGY CURRICULUM*

Highway and Structural Options

COURSE TITLE	Hours per week for 16-week semester				
FIRST SEMESTER	Class	Lab.	Outside Study	Total	Cr. Hrs.
Materials (chemistry and properties)	2	3	4	9	3
Technical drawing	1	7	4	12	4
Technical mathematics I	5	0	10	15	5
Technical physics (mechanics)	3	2	4	9	3
Communication skills	3	0	6	9	3
Highway and structural technology seminar+	1	0	2	3	0
	15	12	30	57	18
SECOND SEMESTER					
Construction methods and equipment	3	0	6	9	3
Mechanics (statics and dynamics)	3	0	6	9	3
Surveying and measurements	2	6	4	12	4
Technical mathematics II	5	0	10	15	5
Technical physics II	3	2	4	9	3
	16	8	30	54	18

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*U.S. Department of Health, Education and Welfare, Office of Education, *Civil Technology: Highway and Structural Options*, 1966, p. 8.

+Italicized words refer to subjects more nearly related to highway safety.

TABLE VI

CIVIL ENGINEERING TECHNOLOGY CURRICULUM*

Highway and Structural Options

COURSE TITLE	Hours per week for 16-week semester				
THIRD SEMESTER	Class	Lab.	Outside Study	Total	Cr. Hrs.
Advanced drafting (highway)	1	7	4	12	4
Industrial organizations and institutions**	3	0	6	9	3
Soils and foundations+	2	3	4	9	3
Strength of materials	3	2	6	11	4
Technical reporting	2	0	4	6	2
Photogrammetry	1	3	2	6	2
	12	15	26	53	18
FOURTH SEMESTER					
Drainage and geology	3	3	6	12	4
Reinforced concrete construction	3	2	6	11	4
Roadway design and construction	3	4	8	15	5
Route design and surveys	2	4	4	10	3
Legal and economic aspects of engineering	2	0	4	6	2
	13	13	28	54	18

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*U.S. Department of Health, Education and Welfare, Office of Education, *Civil Technology: Highway and Structural Options*, 1966, p. 8.

**General and industrial economics (three-hour class) may be chosen as an elective instead of industrial organizations and institutions.

+Italicized words refer to subjects more nearly related to highway safety.

3. Geometric design of streets and intersections
4. Channelization studies
5. Planning of traffic signal installations, operations and maintenance
6. Timing of traffic signals to coordinate flow
7. Planning of sign and street marking programs
8. Study of school and pedestrian crossing
9. Planning of safe school bus routes
10. Surveys of parking and traffic requirements of retail shopping centers
11. Collecting traffic data involving: volume; speed; origin and destination; parking supply and demand; traffic accidents; and lighting levels.

To accomplish these and related tasks the traffic engineering technicians must learn certain concepts and skills. The most important of these are as follows:

1. Communication skills (oral and written) since he will be dealing with people
2. A knowledge of the driver, roadway and vehicle characteristics and an understanding of physical laws as they relate to them
3. The ability to extract design information from manuals and apply it to specified problems
4. A knowledge of data collection methods, tabulation and analysis
5. A knowledge of the operation and maintenance of traffic control devices and equipment
6. The ability to prepare sketches, engineering drawings and to use graphics for illustrative purposes
7. A knowledge of highway capacity analysis
8. The basic principles of traffic and highway engineering
9. An appreciation of the general concepts and principles of related fields--particularly urban planning and police traffic supervisions.[6]

Koert (1969) developed a basic curriculum for traffic engineering technology, which is shown in Table VII and Table VIII. It is designed as a two-year associate degree program. Koert suggests that the curriculum is flexible and that local traffic characteristics, student characteristics and existing highway design, construction, and maintenance related technology programs should be taken into consideration when planning a program.

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[6] Adrian H. Koert, *Traffic Engineering Technician Programs in the Community College*, 1969, p. 3.

TABLE VII

TRAFFIC ENGINEERING TECHNOLOGY CURRICULUM*

FIRST YEAR

Course Title	Class Hours	Lab Hours	Semester Credit
FIRST SEMESTER			
Introduction to traffic engineering+	1	3	2
Engineering drawing	1	6	3
Technical mathematics I	4	0	4
Technical physics I	3	3	4
Communication skills	3	0	3
Physical education	0	2	1
	12	14	17
SECOND SEMESTER			
Principles of traffic administration and safety	2	0	2
Graphics	1	6	3
Technical mathematics II	4	0	4
Technical physics II	3	3	4
Communication skills	3	0	3
Physical education	0	2	1
	13	11	17

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*Adrian H. Koert, *Traffic Engineering Technician Programs in the Community College*, 1969, pp. 20-21.

+Italicized words refer to subjects more nearly related to highway safety.

TABLE VIII

TRAFFIC ENGINEERING TECHNOLOGY CURRICULUM*

SECOND YEAR

Course Title	Class Hours	Lab Hours	Semester Credit
THIRD SEMESTER			
Field traffic surveys+	3	3	4
Control devices	3	0	3
Geometric design	3	3	4
Statistics	3	0	3
Social science (govt., soc.) elective	3	0	3
	15	6	17
FOURTH SEMESTER			
Traffic studies	3	3	4
Traffic laws and regulations	3	0	3
Urban transportation planning	3	3	4
Data processing	2	3	3
Social science (govt., soc.) elective	3	0	3
	14	9	17
TOTALS	54	40	68

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*Adrian H. Koert, *Traffic Engineering Technician Programs in the Community College*, 1969, pp. 20-21.

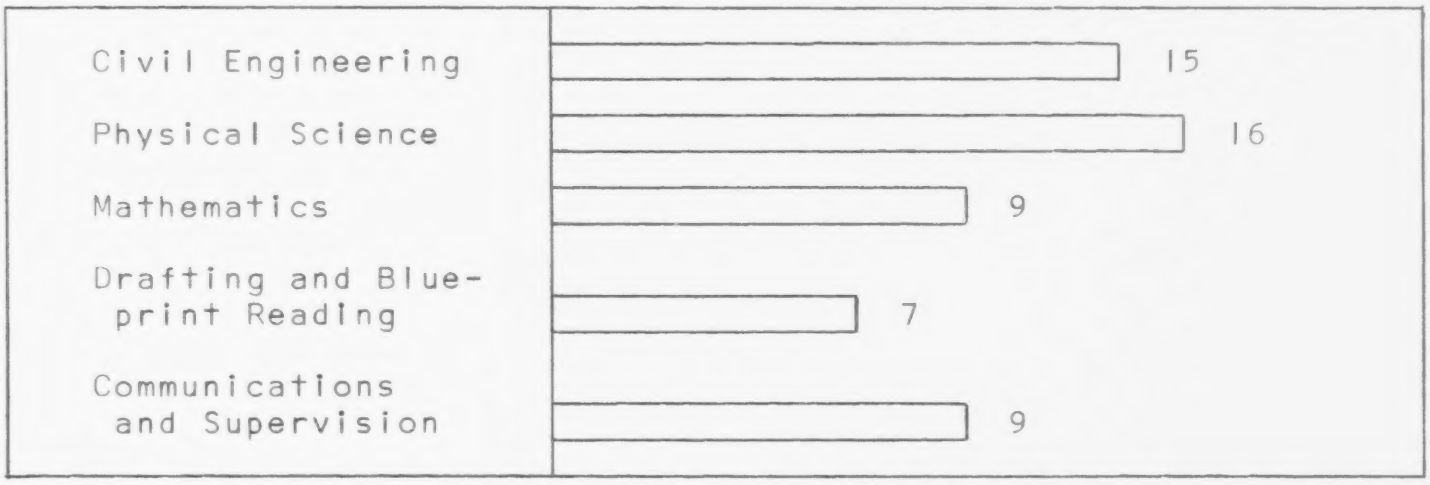
+Italicized words refer to subjects more nearly related to highway safety.

The curriculum in Table VII and Table VIII represents a mix of technical courses, basic science courses and nontechnical courses. A careful study must be made of local employment needs, logically with the assistance of an advisory committee, to determine if this mix of major subject elements is appropriate and meaningful.

A basic curriculum for a certificate program in civil engineering technology was developed by the California State Department of Education in 1963. This curriculum was based upon job descriptions and analyses supplied by industry throughout the State of California. A consensus of the job descriptions and job analyses showed that 57 percent of the time civil engineering technician's time was spent in activities involving instruments, drawings, reports, records, handbooks, equipment, materials and activities in production. The remainder of the time was spent in the following activities: planning, 13 percent of the time; supervising, 12 percent of the time; coordinating, 10 percent of the time; and inspecting, eight percent of the time. Table IX shows the recommended subject matter elements, which represent a consensus of the job descriptions and job analyses supplied by industry. The curriculum elements shown in Table IX "can be supplemented to meet the standards set for an Associate in Arts degree in civil engineering technology. All basic courses can serve as a foundation for further study beyond the degree or certificate that is issued so that students may continue their education throughout their job careers."[7]

TABLE IX

CIVIL ENGINEERING TECHNOLOGY
SEMESTER UNITS RECOMMENDED FOR CERTIFICATE PROGRAM*



*California State Department of Education, *Civil Engineering Technology*, 1963, p. 7.

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[7] California State Department of Education, *Civil Engineering Technology*, 1963, p. 7.

TABLE X

HIGHWAY SAFETY SITE OFFICER*

Scope

Includes all staff and their supervisors involved in functions devoted to the safety of highway department personnel and of the public at sites of highway department activity.

Duties

Performs technical and supervisory duties in such areas as: the development and utilization of safety equipment; the elimination of or modification of hazardous working conditions, equipment, or materials; the investigation of accidents to determine causal factors and to recommend remedial measures; the inspection of construction and maintenance work on state highways to determine and enforce compliance with departmental safety requirements; and the dissemination and review of educational materials.

Entering Education

High school graduate or the equivalent.

Entering Experience

At least three years experience as a foreman or supervisor in highway construction and maintenance work or the equivalent.

Special Training

- Upon appointment, a minimum of 40 hours training of which 10 hours should be devoted to obtaining a general knowledge of the highway safety program and 30 hours should be allocated to acquiring technical skills and an understanding of the principles and practices of employee and construction site safety.
- A minimum of 24 hours in-service training annually in order to review previous training and to examine new developments.

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*Extracted from *Safety Specialist Manpower*, Vol. I, Booz-Allen and Hamilton, Inc., 1968, Appendix B (26).

TABLE XI

ENGINEERING AIDE--SAFETY*

Scope

Includes all technically trained aides to highway engineers involved in unique safety aspects of the design, construction, and maintenance of highways.

Duties

Under supervision of a highway engineer, performs technical duties related to the safety aspects of location, design, construction, and maintenance of highways, bridges, and other highway structures.

Entering Education

High school graduate with courses in mathematics or the equivalent.

Entering Experience

A minimum of three years experience in the technical activities of a state highway department or the equivalent.

Special Training

- Upon appointment, a minimum of 40 hours training at the junior college level devoted to obtaining a general knowledge of the highway safety program.
- Upon appointment, if not previously obtained, a minimum of 80 hours of training at the junior college level devoted to acquiring the skills required to perform technical duties in the safety aspects of highway design, construction, and maintenance.
- A minimum of 24 hours in-service training annually in order to review previous training and to examine new developments in design, construction, and maintenance within the context of the highway safety program.

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*Extracted from *Safety Specialist Manpower*, Vol. I, Booz-Allen and Hamilton, Inc., 1968, Appendix B (26).

TABLE XII

ACCIDENT SITE INVESTIGATOR AIDE*

Scope

Includes all state employed technically trained aides to Accident Site Investigators, including personnel with either engineering or enforcement backgrounds.

Duties

Under the supervision of Accident Site Investigators, aids in investigating accident sites in order to collect data concerning causes of and factors contributing to accidents. Assists in the analysis of data and preparation of recommendations for engineering and enforcement measures aimed at removing or reducing factors contributing to accidents and their effects.

Entering Education

High school graduate or the equivalent.

Entering Experience

At least three years of progressively responsible experience in highway planning, surveys, design, construction, maintenance, operations, enforcement, inspection, laboratory, research, related fields, or the equivalent.

Special Training

- Upon appointment, a minimum of 120 hours training at the junior college level, of which 40 hours should be devoted to obtaining a general knowledge of the highway safety program and of the relationship of highway design, construction, maintenance, traffic operations, and enforcement to the prevention and reduction of accidents or the alleviation of their aftereffects; 80 hours should be devoted to acquiring the requisite technical skills for accident site investigation data collection and analysis.

- A minimum of 24 hours in-service training for the purpose of reviewing previous training and examining new developments within accident site investigation.

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*Extracted from *Safety Specialist Manpower*, Vol. I, Booz-Allen and Hamilton, Inc., 1968, Appendix B (19).

TABLE XIII

ENGINEERING AIDE--SAFETY*

ENTRY AND REFRESHER TRAINING CURRICULA

Entry Training		Refresher Training		Percent of Total Training Hours by Discipline	
Course Description	No. of Hours	Course Description	No. of Hours	Public or Bus. Admin.	Engineering
A. General Knowledge of the Highway Safety Program	10	A. A Review and Examination of New Developments within the Highway Safety Program and Traffic Control Devices	24 YR.	8	92
B. The Impact of the Highway Safety Program on Traffic Operations Activities and Traffic Control Devices	30				
C. The Technical Duties in the Areas of Traffic Operations and Traffic Control Devices as Related to Highway Safety	80				

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*Selected from *The Feasibility of Establishing Highway Safety Manpower Development and Research Centers at University Level Institutions*, Vol. 1, Stanford Research Institute, 1969, p. 12.

TABLE XIV

HIGHWAY SAFETY SITE OFFICER*

ENTRY AND REFRESHER TRAINING CURRICULA

Entry Training		Refresher Training		Percent of Total Training Hours by Discipline	
Course Description	No. of Hours	Course Description	No. of Hours	Public or Bus. Admin.	Engineering
A. General Knowledge of the Highway Safety Program	10	A. A Review and Examination of New Developments	24 YR.	25	75
B. Principles and Practices of Employee and Construction Site Safety with Relation to the Highway Safety Program	30				

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*Selected from *The Feasibility of Establishing Highway Safety Manpower Development and Research Centers at University Level Institutions*, Vol. I, Stanford Research Institute, 1969, p. 12.

TABLE XV

ENGINEERING AIDE--SAFETY*

ENTRY AND REFRESHER TRAINING CURRICULA

Entry Training		Refresher Training		Percent of Total Training Hours by Discipline	
Course Description	No. of Hours	Course Description	No. of Hours	Public or Bus. Admin.	Engineering
A. General Knowledge of the Highway Safety Program	40	A. A Review and Examination of New Developments in Design, Construction, and Maintenance within the Context of the Highway Safety Program	24 YR.	33	67
B. The Impact of the Highway Safety Program on Highway Design, Construction, and Maintenance	80				

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*Selected from *The Feasibility of Establishing Highway Safety Manpower Development and Research Centers at University Level Institutions*, Vol. 1, Stanford Research Institute, 1969, p. 12.

C. OTHER SAFETY RELATED CURRICULA ELEMENTS

Numerous program curricula, particularly in the civil and highway technology areas, have been reviewed. Several representative curricula elements are exhibited in the Appendix. The principal purposes for including these in the package is to call attention to the unique highway safety related subjects incorporated in various program curricula and to identify potential sources of materials for use in planning and developing programs parallel to highway safety manpower needs. Most of these were accumulated through the survey conducted by The Center for Vocational and Technical Education, The Ohio State University. Although many of the curricula subject elements have implications in highway safety, some materials are more significant in terms of the objectives of this project. These have been carefully reviewed and synthesized when necessary. Some are presented in original forms while others are in abbreviated forms.

It should be emphasized again that the curricula elements relate more closely to the civil and highway technology area (highway safety engineering aide). Also, most of the materials have been extracted from two-year associate degree curricula. The original materials are designed for the post-secondary educational institutions.

The New York State Department of Transportation and the New York State Department of Education collaborated to plan and develop the following highway technology subject area teachers' guides: *Unit II, Highway Drawing; Unit IV, Elements of Highway Planning; Unit V, Soils and Drainage; and Unit VI, Highway Design and Estimating*.[8] Additional materials are being planned and will be prepared in final form on a priority schedule identified by the New York State Department of Transportation. These include the following subject areas: Construction and Inspection; Highway Structure; Highway Maintenance; and Traffic Engineering. The subject areas have been planned in the sequenced order shown. The material consists of lesson plans in a two-column outline format. One column lists the content topics and sub-topics. The other column lists suggested teaching points and techniques. Each lesson plan includes references, lesson objectives, questions for review and student assignments. Since the material is designed specifically for employed personnel, simulated skill building exercises are not emphasized to a great extent. However, student practices are integrated into the curriculum when feasible, particularly in the highway drawing and highway design and estimating subject areas.

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[8] *Program for Highway Technicians*, 4 volumes, The State University of New York, 1967-69.

These materials are prepared for use in adult education classes to upgrade technicians in the highway design, construction, and maintenance field. Students completing the various courses will be prepared for advanced work in highway planning.

The materials developed for two of the subject areas mentioned above, highway design and highway planning, have significant relevance to highway safety. Many of the highway safety elements stemming from the passage of the Highway Safety Act of 1966 have been incorporated into the material.

An abbreviated, and somewhat revised form of the *Unit VI, Elements of Highway Planning* is presented in the Appendix in Exhibit A. This abbreviated outline is taken largely from the content outline of the material. Some of the content oriented to the State of New York has been omitted, or revised to apply to all states. Lesson summaries, teaching points and techniques and student assignments have been omitted for brevity.

The teacher's guide for *Unit VI, Highway Design and Estimating* is an equally exemplary product which also impacts on the most recent developments in highway safety. This material is in the same format as *Unit VI, Elements of Highway Planning*. Numerous geometric and trigonometric applications are incorporated into the material. Twenty-one figures which give pictorial representation to many of these applications are also included. Although the material is too detailed and comprehensive to be included in this report, the content topics included in the materials are shown in the Appendix in Exhibit B.

A third teacher's guide, *Unit II, Highway Drawing*, contains one section with pertinent highway safety subject matter. This section is presented in Exhibit C in the Appendix.

Other subject elements selected from various sources are also exhibited in the Appendix.

V. CONCLUSIONS

A. Due to the permanence of streets and highway structures and the increasing traffic which these structures must accommodate, it is essential that many physical factors, informational factors (signals, signs, etc.) and other environmental elements which contribute to safety, be of primary concern to personnel responsible for the design, construction, and maintenance of highways. The federal government and the states are providing incredible sums of money for the primary-secondary-urban program of highway construction. This is creating a greater need for safety specialists and technicians to assist in the development and application of engineering science to insure that the risks of accidents and resulting deaths, injuries and property damage are kept at a minimum.

B. Personnel representing numerous occupations are employed in the highway design, construction, and maintenance industry. Only those occupations which encompass unique aspects of highway safety are considered in this report. Generally, these personnel provide support to professional engineers who incorporate highway safety applications into the design of structures or provide support to engineers in the construction of roadways. They may also provide guidance and direction to construction and maintenance craftsmen.

C. The highway safety site officer and the highway safety engineering aide have been identified as the principal occupational education targets. The highway safety site officer represents a supervisory level position. The safety engineering aide may represent a technical level position directly under the professional engineer or an intermediate level position between the engineer and technician and/or highway construction and maintenance craftsman. These are positions with potential inherent control in implementing the states' programs of highway design, construction, and maintenance to improve highway safety.

D. Some questions remain to be answered in regard to the duties and responsibilities of the highway safety engineering aide. Lack of evidence exists as to the exact nature of activities encompassed in this position. The titles and job descriptions encountered in this project, which can be identified with the highway safety engineering aide, indicate that several common occupational titles are encompassed in the aforementioned title. These include the civil engineering aide, civil engineering technician, highway technician, highway engineering technician, traffic engineering aide and traffic engineering technician. All these positions entail highway safety to some extent, depending upon geographic locations and the employment firm. Also, a review of numerous programs of instruction in post-secondary educational institutions, and training materials used in conjunction with the programs of instruction, indicates that there is diversity in subject matter content introduced to students enrolled. Most of the curriculum materials reviewed during the course of this project do not reflect the task analyses approach to curriculum development.

E. More information is needed concerning the exact nature of the duties and responsibilities of the highway safety site officer. It is assumed that this individual should be quite familiar with highway construction procedures. Additional insights are needed in order to be able to plan and establish training programs.

F. Based upon the results of several studies made of manpower needs for technicians and specialists in highway design, construction, and maintenance, there is a shortage of trained manpower for positions as highway safety site officers and highway safety engineering aides. The need appears to be much greater for trained highway safety engineering aides and closely associated positions, e.g., civil engineering technicians and traffic engineering aides.

G. No training for highway safety site officers was found to be in existence or planned in secondary and post-secondary public institutions. Most of the programs identified in secondary and post-secondary institutions which are identified with highway design, construction, and maintenance are entitled "Civil Technology." Most of these programs prepare personnel for positions more closely associated with the highway safety engineering aide.

H. Provisions must be made for both in-service and preservice instruction to prepare personnel as highway safety site officers and highway safety engineering aides. Many of the students will likely come from agencies and firms presently employing personnel who desire to move into highway safety positions, but lack the necessary knowledges and skills demanded. Training may be offered in the form of short courses, seminars, workshops, or the two-year associate degree type program.

I. There are currently some prerequisites for students entering programs and courses relating to highway design, construction, and maintenance which may not be compatible to training programs for highway safety site officers and highway safety engineering aides. Examples are as follows: students must have a high school diploma or the equivalent; and students must have passed the Scholastic Aptitude Test. Such requirements may have negative implications for in-service training.

J. In most instances programs have been developed with the assumption that graduates would be eligible to function as assistants for any one of a cluster of professional jobs within governmental agencies and private firms. The curricula is designed to provide a broad base of knowledges and skills with the anticipation that the graduate can gain entrance into one of several career areas, or be promoted to an area of increased responsibility. These programs normally are divided into three or four basic subject areas, e.g., basic mathematics and science courses, general academic courses, and technical specialty courses. Some institutions are making provisions for student options the second year of two-year associate degree programs. The second year is more heavily oriented toward the technical specialty subjects.

K. Most of the post-secondary educational institutions require that their instructional staffs for civil technology and related programs have an M.S. or B.S. degree in the related field of study, plus at least two years of experience in the area in which they will instruct. However, there has been increased emphasis to hire civil technicians for instructional roles due to the shortage of qualified personnel. It will be difficult to locate and hire qualified instructors for the highway safety programs in question.

L. Although the curriculum content for training highway safety engineering aides is somewhat vague, it is assumed that the existing facilities and equipment for civil technology and similar programs of instruction would at least be partially adequate for training highway engineering aides. These facilities and equipment may also have some application for training highway safety site officers. Of course, in-service programs would likely require fewer pieces of equipment and supplies.

M. It is assumed that the existing instructional staffs for civil technology and similar programs are capable of performing at least part of the instructional task for training highway safety engineering aides. It remains to be seen as to whether this staff could provide instruction for training highway safety site officers. This is not suggesting that instructors are expected to take on additional instructional loads, but rather implying that they might absorb at least part of the change in instructional emphasis in existing programs and/or assist new staff members in new programs.

N. Very few curriculum materials which are directly tied to national and state highway safety programs were accumulated from vocational and technical education sources. Only two state curriculum centers appear to be active in developing curriculum materials for programs of instruction in highway design, construction, and maintenance. Respondents to the survey indicated that they do not rely upon state curriculum centers as primary sources for instructional materials. Most of the materials acquired from the program chairmen included brief course descriptions and brief course outlines with general objectives, time allotments, and suggested references. In most instances the highway safety emphasis could not be determined.

O. Since the instructors must assume the responsibility for developing most of their program curricula, the subject elements included in each curriculum reflect the educational and experience background of the individual developing the material. For example, if the instructors have accumulated experience in highway planning and design the curriculum is heavily oriented to this area.

VI. DISCUSSION--RESEARCH TOPICS

A. To what extent are maintenance foremen and supervisors, of highway construction and maintenance crews, engaged in highway safety activities as defined in *Highway Design, Construction, and Maintenance: Highway Safety Program Standard 12*? Can job and task analyses be performed as a base for developing curriculum for training highway safety site officers? If not, what would be the most feasible strategies for curriculum development in this area?

B. What unique knowledges and skills in highway safety are needed by personnel presently employed as civil technicians, civil engineering aides, highway engineering aides, and traffic engineering technicians? How can these knowledges and skills be identified? Which occupations encompass the greatest amount of contact with the safety aspects of highway design, construction, and maintenance? How could a minimum degree of standardization be established for curriculum encompassing new highway safety elements?

C. What adjustments would existing programs of instruction, which are closely associated to the highway safety aspects of design, construction, and maintenance, have to make in order to incorporate new elements specified by the *Highway Safety Standard*? Would existing facilities and equipment be adequate and appropriate for training highway safety engineering aides? What new curriculum elements would need to be developed? How much additional cost would be involved for new equipment, supplies, instructional staff, etc.?

D. What type facilities, equipment, and supplies would be necessary for training highway safety site officers? How would the specifications differ for in-service and preservice type programs? Is it realistic to assume that preservice type training can be provided for students to gain entrance knowledges and skills as highway safety site officers? What would be the source for qualified instructors? Are present instructional staffs in highway technology and associated programs qualified to instruct highway safety site officers? If not, what additional knowledges and skills would these instructors need in order to perform this task?

E. What can be done to interest employed personnel, who are potential candidates for advanced positions as highway engineering aides or highway safety site officers, to enroll in programs of instruction? Can employers, both governmental and private, be expected to cooperate in attempting to interest employees in seeking further training and subsequently in assisting in providing the advancement opportunities for these workers? Would employers cooperate in planning, developing, and evaluating cooperative or work-study type training?

F. Are current graduates from highway technology and associated programs qualified to function as supportive personnel to any one of a cluster of professional jobs within governmental agencies and private firms? Should the basic subject elements of science, mathematics, technical specialty courses, and general education courses be closely studied for possible inclusion of more specialized courses that relate to highway safety?

G. What types of curriculum materials are most needed for training programs? Examples are: 1) detailed technical subject matter covering broad areas of instruction: 2) technical subject matter in brief outline form; 3) student oriented materials covering job activity procedures; 4) tools, equipment, and supply lists; 5) audiovisual materials; and 6) test instruments for measuring student progress.

H. Is there an adequate supply of resource materials, which contain the safety aspects of highway design, construction, and maintenance, available from commercial sources? What are the strengths and weaknesses of these materials?

I. In what ways can the state curriculum materials centers provide the greatest assistance to instructors?

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3A Measuring Traffic Volumes
3B Determining Travel Time
3C Conducting a Limited Parking Study
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4A Measuring Transit Service
5A Inventory of the Physical Street System

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APPENDICES

EXHIBIT A

ELEMENTS OF HIGHWAY PLANNING*

UNIT 1: FUNDAMENTALS OF HIGHWAY PLANNING

TRAINING TIME:

OBJECTIVES

1. To acquaint the student with the basic concept of highway planning as a science.
2. To show the relationship between highway planning and comprehensive planning for an area.

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2. Matson, T. M.; Smith, W. S.; and Hurd, S. W. *Traffic Engineering*. New York: McGraw-Hill, 1955.
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UNIT OUTLINE

I. Determining Needs for New or Improved Roads
    A. Inventory of roads
    B. Studies of traffic volume and classification of roads
    C. Traffic analyses
        1. Average annual daily traffic (AADT)
        2. Design Hour (DH)
    D. Traffic forecasting
    E. Geometrics

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*Taken largely from *Program for Highway Technicians: Unit IV, Elements of Highway Planning*, The New York State Education Department, Albany, New York, 1969, pp. 1-106.

II. Determining Location of Roads
   A. Mapping
   B. Origin and destination studies
   C. Economic analysis
   D. Route location

III. The Relation of Highway Planning to Other Types of Planning
   A. Community planning
      1. Planning board
      2. Planning staff
      3. Duties
      4. Coordination
   B. Regional planning
      1. By public agency
      2. By a quasi-public agency

SUGGESTED STUDENT PRACTICES:

UNIT 2: STATE HIGHWAY AGENCIES AND SYSTEMS

TRAINING TIME:

OBJECTIVES

1. To acquaint the students with the various highway agencies and systems.

2. To show why planning for state highways should be coordinated with planning with other highway systems.

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UNIT OUTLINE

I. State Highway Agencies
    A. Public agencies
        1. State Department of Transportation
        2. State Highway Department
        3. United States Department of Transportation
        4. County agencies
        5. Township agencies
        6. Municipality agencies
    B. Quasi-public agencies (transit authorities, etc.)

II. State Highway Systems
    A. Highways receiving federal aid
        1. Primary highways
        2. Secondary highways
            a. State
            b. County
    B. Special kinds of primary highways
        1. Interstate
        2. Arterials
        3. Expressways
        4. Parkways

C. Highways not receiving federal aid
  1. State system
  2. County system
  3. Town roads
  4. City and village streets

D. Quasi-public highways

III. Coordination Among Highway Agencies

SUGGESTED STUDENT PRACTICES:

UNIT 3: ROAD INVENTORY AND FIELD SCORING

TRAINING TIME:

OBJECTIVES

1. To acquaint students with the elements of road inventory and field scoring.
2. To fit the inventory and field scoring into the highway planning process.

REFERENCES

1. Highway Research Board. *Highway Capacity Manual*. Washington: The Highway Research Board, 1965.
2. Woods, K. B. *Highway Engineering Handbook*. New York: McGraw-Hill, 1960.

UNIT OUTLINE

I. Inventory of Roads
  A. Elements of the inventory
    1. Length of roads
    2. Width of roads
    3. Type of paving
    4. Development of surrounding areas
  B. Use of inventory data
    1. For highway planning
    2. As a basis for allocating aid to towns and counties

II. Field Scoring
  A. Surface and structural condition
  B. Maintenance condition
  C. Relation of volume to capacity

III. Sufficiency Ratings
  A. Averaging field scores
  B. Index and number
  C. Engineering judgement

SUGGESTED STUDENT PRACTICES:

UNIT 4: MAPPING AS A PLANNING TOOL

TRAINING TIME:

OBJECTIVES

1. To acquaint the students with three kinds of maps in common use for highway planning.

2. To show the students the uses of three different kinds of maps in highway planning, highway engineering, and related fields.

REFERENCES

1. Woods, K. B. *Highway Engineering Handbook*. New York: McGraw-Hill, 1960.

UNIT OUTLINE

I. Kinds of Maps
  A. Planimetric maps
    1. Highway planning series (HPS) county maps
    2. Highway planning series city maps
    3. Travel guides and atlases
    4. Sandborn maps
    5. Photo maps
  B. Photogrammetric maps
    1. Ground controls needed
    2. Map scaled used
  C. United States geological survey maps
    1. Functions of U.S. geological survey maps
    2. Updating maps
  D. Aerial photo maps
    1. The usual scale
    2. Another scale used

II. Uses of Maps
  A. Planimetric maps
    1. Highway planning series (HPS) county maps
    2. Highway planning series city maps
    3. Travel guides and atlases
    4. Sandborn maps
    5. Photo maps
  B. Photogrammetric maps
    1. Main uses
    2. Other uses

C. United States geological survey maps
D. Aerial photos

SUGGESTED STUDENT PRACTICES:

Using 100-200 words, write a summary of the comparison of a mapping program by a commercial map company to a program prepared by a state highway agency staff.

UNIT 5: TRAFFIC STUDIES

TRAINING TIME:

OBJECTIVES

1. To acquaint the students with four types of traffic survey studies forming the basis for highway design.

2. To show how each survey serves a specific purpose in highway planning for smaller areas.

REFERENCES

1. American Association of State Highway Officials. *A Policy on Geometric Design of Rural Highways*. Washington, D.C.: The American Association of State Highway Officials, 1966.

UNIT OUTLINE

I. Volume Counts of Traffic
    A. Machine method
        1. Fixed detectors
        2. Portable detectors
        3. Printed tape recorders
        4. Punched-tape recorders
        5. Computer control
    B. Manual methods

II. Origin and destination surveys
    A. Roadside interview
        1. Spot survey
        2. Survey screen
        3. Cordon around area
    B. Other origins and destination surveys

III. Classification Counts
    A. Comprehensive data collection
    B. Short-term count

IV. Turning Count

V. Uses of Traffic Surveys

SUGGESTED STUDENT PRACTICES:

UNIT 6: TRAFFIC ANALYSIS

TRAINING TIME:

OBJECTIVES

1. To show the major steps in making a simple traffic analysis for a small-area study.

2. To show how an analysis is used in highway planning for such an area.

REFERENCES

1. Matson, T. M.; Smith, W. S.; and Hurd, S. W. *Traffic Engineering*. New York: McGraw-Hill, 1955.

2. Winch, D. M. *Economics of Highway Planning*. Toronto, Canada: University of Toronto Press, 1963.

UNIT OUTLINE

I. Analysis of Traffic Flow
    A. Average annual daily flow of traffic (AADT)
        1. Continuous count
        2. Short count
    B. Design Hour (DH)
        1. With a continuous count
        2. With a short count
    C. Composition of traffic
        1. Equivalent traffic count
        2. Effect on road design

II. Analysis of Travel Characteristics
    A. Origin and destination (OND surveys)
        1. Traffic through
        2. Local traffic
    B. Assignment of traffic through bypass
        1. Diversion curve
        2. Variation from the curve

III. Application of Traffic Analysis
    A. Approving existing routes
    B. Planning the bypass

SUGGESTED STUDENT PRACTICES:

UNIT 7: TRAFFIC FORECASTING

TRAINING TIME:

OBJECTIVES

1. To acquaint the students with the procedures for making traffic forecasting for road networks in small areas.

2. To show how traffic forecasts, as developed through this course, are used in highway planning.

REFERENCES

1. Automobile Manufacturer's Association. *Highways for the Future*. Detroit, Michigan: Automobile Manufacturer's Association, 1961.

2. Hay, W. W. *Introduction to Transportation Engineering*. New York: John Wiley, 1961.

3. Woods, K. B. *Highway Engineering Handbook*. New York: McGraw-Hill, 1960.

UNIT OUTLINE

I. Principles of Traffic Forecasting
    A. Selection of forecast period
        1. Ten-year forecast
        2. Twenty-year forecast
        3. Thirty-year forecast
        4. Forecast for a longer period
    B. Obtaining traffic figures for the base year
        1. Declining trend
            a. Estimating the traffic
            b. Analyzing decline
            c. Overall study needed
        2. Static trend
        3. Upward trend
    C. Extension factors influencing forecast
        1. Normal traffic
        2. Generated traffic
        3. Development traffic
    D. Computation for forecasting

II. Uses of Traffic Forecasts

SUGGESTED STUDENT PRACTICES:

UNIT 8: GEOMETRICS AND DESIGN STANDARDS

TRAINING TIME:

OBJECTIVES

1. To show the students how design standards vary from traffic volume, type of terrain, and type of area development.
2. To acquaint the students with the basic standards used for design of state highways.
3. To show how geometrics are selected by the highway planner.

REFERENCES

1. American Association of State Highway Officials. *A Policy on Geometric Design of Rural Highways*. Washington, D.C.: The American Association of State Highway Officials, 1966.
2. Highway Research Board. *Highway Capacity Manual*. Washington, D.C.: The Highway Research Board, 1965.
3. Matson, T. M.; Smith, W. S.; and Hurd, F. W. *Traffic Engineering*. New York: McGraw-Hill, 1955.
4. National Highway Users' Conference. *Federal Aid for Highways*. Revised edition. Washington, D.C.: The National Highway Users' Conference, 1959.
5. Winch, D. M. *Economics of Highway Planning*. Toronto, Canada: University of Toronto Press, 1963.

UNIT OUTLINE

I. Factors Affecting Design Standards
    A. Traffic volume
        1. Determines design standard
        2. Varies with length of time
    B. Terrain characteristics
    C. Developed areas

II. State Geometric Standards
    A. Standards for expressways

        1. Rural expressways
        2. Urban expressways
    B. Standards for rural highways
    C. Standards for urban arterials

III. Selection of Geometrics

IV. Introduction to Advanced Design Standards

SUGGESTED STUDENT PRACTICES:

UNIT 9: ROUTE LOCATION

TRAINING TIME:

OBJECTIVES

1. To explain the basic differences between highway planning and preliminary engineering, as they effect route locations.
2. To review the basic elements of route location in small cities, as for a village bypass.

REFERENCES

1. Hay, W. W. *Introduction to Transportation Engineering.* New York: John Wiley, 1961.
2. Woods, K. B. *Highway Engineering Handbook.* New York: McGraw-Hill, 1960.

UNIT OUTLINE

I. Differences Between Highway Planning Preliminary Engineering
    A. Determining the corridor
    B. Determining the route

II. How to Select the Corridor

III. How to Determine the Route Location
    A. Review of the route-study
    B. Use of photogrammetric maps
    C. Use of reconnaissance
        1. Construction problems
        2. Right-of-way cost
    D. User-benefit analysis
    E. Revision of economic analysis
    F. Route-location report

SUGGESTED STUDENT PRACTICES:

UNIT 10: HIGHWAY SAFETY

TRAINING TIME:

OBJECTIVES

1. To acquaint the students with federal and state programs for highway safety.
2. To acquaint the class with the Department of Transportation procedures for implementing the state safety program.
3. To inform the students of safety measures such as pavement striping, signing, signals, and others.

REFERENCES

1. Hay, W. W. *Introduction to Transportation Engineering.* New York: John Wiley, 1961.
2. Matson, T. M.; Smith, W. S.; and Hurd, F. W. *Traffic Engineering.* New York: McGraw-Hill, 1955.
3. New York State Traffic Control Commission. *Manual of Uniform Traffic Control Devices.* Albany, New York: The New York State Traffic Control Commission, 1967.
4. United States Department of Transportation. Bureau of Public Roads. *Bureau of Public Roads Policy and Procedure Memorandum 21-16*, Transmittal 44. Washington, D.C.: United States Department of Transportation, 1965.
5. United States Congress. *United States Highway Safety Act of 1966.* Public Law 89-564. Section 402. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1966.
6. Winch, D. M. *Economics of Highway Planning.* Toronto, Canada: University of Toronto Press, 1963.
7. Woods, K. B. *Highway Engineering Handbook.* New York: McGraw-Hill, 1960.

UNIT OUTLINE

I. Accent on Safety
    A. The federal safety program

- B. The state program for highway safety

II. The Department of Transportation Safety Crusade
  - A. Updating safety standards
  - B. Spot improvements of unsafe conditions

III. Standard Safety Measures
  - A. Road markings
  - B. Signs for safety
  - C. Traffic signals and devices

SUGGESTED STUDENT PRACTICES:

UNIT 11: HIGHWAY LAW

TRAINING TIME:

OBJECTIVES

1. To acquaint the students with the state laws associated with the design, construction, and maintenance of highways.
2. To show how a knowledge of these laws will help employees carry out the functions of the agency in which they work.

REFERENCES

1. United States Congress. *The United States Federal-Aid Highway Act of 1962*. Public Law 87-866. Section 134. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1962.
2. U.S. Congress. *United States Highway Safety Act of 1966*. Public Law 89-564. Section 402. Washington, D.C.: Superintendent of Documents, U.S. Government Printing Office, 1966.

UNIT OUTLINE

I. State Highway Laws

II. The Law Making Process
    A. Reason for changes in laws
    B. Drafting, submitting and introduction of bill to legislature

III. Details of Highway Laws
    A. Court interpretations
    B. Changes made in laws

IV. Other Laws Related to Highways
    A. State laws
    B. Federal laws

SUGGESTED STUDENT PRACTICES:

UNIT 12: INTRODUCTION TO URBAN TRANSPORTATION PLANNING

TRAINING TIME:

OBJECTIVES

1. To introduce the students to the process of transportation planning for urban areas.

REFERENCES

1. Automobile Manufacturer's Association. *Highways for the Future*. Detroit, Michigan: The Automobile Manufacturer's Association, 1961.
2. Automobile Manufacturer's Association. *Urban Transportation Issues and Trends*. Detroit, Michigan: The Automobile Manufacturer's Association, 1961.
3. Hay, W. W. *Introduction to Transportation Engineering*. New York: John Wiley, 1961.
4. Woods, K. B. *Highway Engineering Handbook*. New York: McGraw-Hill, 1960.

UNIT OUTLINE

- I. Evolution of Urban Transportation Planning
    - A. Finding minimum travel time
    - B. Method of finding minimum travel time
        - 1. Manual methods not feasible
        - 2. Mathematical methods
- II. Mathematical Models
    - A. Terminology
        - 1. Node
        - 2. Link
        - 3. Route
        - 4. Tree
    - B. Gravity model
    - C. Intervening opportunities model
    - D. Competing opportunities model
    - E. Special purpose model
- III. Fundamentals of Urban Transportation Planning
    - A. Approaches
        - 1. Cordon system

    2. Screen-line system
    3. Land-use
- B. Techniques in the land-use system
    1. Trip generation
    2. Trip distribution
    3. Traffic assignment
- C. The plan

SUGGESTED STUDENT PRACTICES:

EXHIBIT B

HIGHWAY DESIGN AND ESTIMATING*

1. Introduction
2. Sequence of Design (Phase 1)
3. Highway Classification
4. Features of Design
5. Features of Design
6. Horizontal Alignment (Control of Curvature)
7. Horizontal Alignment (Superelevation Runoff)
8. Elements of Horizontal Alignment
9. Vertical Alignment (Criteria and Controls)
10. Typical Sections and Standard Structure Sheets
11. Geometric Auxiliaries
12. Sequence of Design (Second, Third, and Fourth Phases)
13. The Engineer's Estimate
14. Report on Design and Estimate

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*Extracted from *Program for Highway Technicians: Unit VI, Highway Design and Estimating*, The New York State Education Department, Albany, New York, 1968, p. v.

EXHIBIT C

HIGHWAY DRAWING*

UNIT 1: THE HIGHWAY PLAN

TRAINING TIME:

OBJECTIVES

1. To introduce the component parts of the highway plan as might be designed in a state department of transportation of the highway department.

2. To understand the significance of quality work in the finished plan.

UNIT OUTLINE

I. The Highway Plan. The highway plan is a book of plans prepared by the design team to inform the contractor about how to build the highway.
  A. Purpose
    1. Detailed drawings
    2. Detailed notes
  B. Highway design
    1. Terrain, soil, drainage and right-of-way variation factors
    2. Standard sheet
  C. Highway plan divisions
    1. Specified divisions (16)
    2. Significance of divisions to the small project

II. Divisions of Plans
  A. Cover sheet
    1. Title of project
    2. Corner insert
    3. Approval and recommendation
    4. Design staff
    5. Location maps
    6. Design data

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*Taken largely from *Program for Highway Technicians: Unit II, Highway Drawing*, The New York State Education Department, Albany, New York, 1968, pp. 102-110.

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        - a. The design classification of the highway
        - b. Projected traffic count
            - 1. Design hour traffic
            - 2. Annual average daily traffic
- B. Index sheet
- C. Table of maintenance
- D. Small-scale key map
- E. Typical sections and general notes
    - 1. Purpose
    - 2. Scales used in sections
    - 3. Defining sections between certain stations
    - 4. Section description of the items to be used in the construction
    - 5. Specialized conditions
- F. Miscellaneous tables
    - 1. Purpose
    - 2. Elements included
- G. Delineator details
- H. Drainage structures
- I. Miscellaneous details
    - 1. Purpose
    - 2. Elements included
- J. Roadside development
- K. Parking areas
- L. General large-scale plan
    - 1. Purpose
    - 2. Elements included
- M. Profiles
    - 1. Location of profile on plan
    - 2. Elements included
- N. Lighting and traffic control signals
    - 1. When to include traffic and control information
    - 2. Symbols
    - 3. Lighting detail sheet
- O. Bridges
- P. Standard sheets

SUGGESTED STUDENT PRACTICES:

1. Acquire at least one copy of a complete highway plan. Before each class begins, use the plan to review the elements to be discussed during the class period. Use the plan as a reference during all discussions.

2. Using a contract plan (200 ft. scale plan and profile), draw a 15-station portion of the plan on a 50-ft. scale. Work is to be done in pencil on vellum and checked as an overlay on the original 50-ft. contract plan.

EXHIBIT D

TRAFFIC ENGINEERING*

COURSE TOPICAL OUTLINE: GENERAL

Lecture	Lab	Topic
3	1	1. Driver and Vehicle Characteristics affecting Highway Design, Control, and Safety.
6	2	2. Probability and Statistical Methods in analyzing traffic stream or flow, characteristics affecting Highway Planning, Design, Control, and Safety.
6	2	3. Traffic Planning--Systems, Surveys, and Parameters used in Capacity Analysis of existing and proposed facilities.
9	3	4. Geometric Design--the effects of the above studied traffic characteristics on the Plane Geometry, Vertical and Horizontal Alignment design of proposed facilities.
6	2	5. Traffic Control--the elements of, warrants for, design and use of traffic control devices such as signs, delineations, and signals, to promote efficient operation of existing traffic.
30	10	

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*Selected from "Highway Construction Technology Curriculum," Ferris State College, Big Rapids, Michigan, 1967.

COURSE TOPICAL OUTLINE: DETAILED

- I. Driver and Vehicle Characteristics Affecting Highway Design, Control, and Safety
  - A. Driver characteristics
    - 1. Attention
    - 2. Standardization and reflex action
    - 3. PIEV
  - B. Vehicle characteristics
    - 1. Dimensions
    - 2. Turning radii
    - 3. Stopping sight distance
    - 4. Horsepower-grade requirements

- II. Probability and Statistical Methods in Analyzing Traffic Stream, or Flow, characteristics Affecting Highway Planning, Design, Control, and Safety
  - A. Volume characteristics
    - 1. Time-wise
      - a. ADT--planning parameter
      - b. DHV--design and control parameter
    - 2. Space-wise
    - 3. Otherwise
      - a. Percent commercial--capacity and design factor
      - b. Percent directional--capacity factor
  - B. Arrival and headway distributions: actual statistical distributions relative to the theoretical poisson probability distribution (a study within the DHV)
  - C. Speed--significance and methods of measurement
    - 1. Spot speed--design and control parameter
    - 2. Running speed--design parameter
    - 3. Overall speed--planning parameter
    - 4. Speed limit--control parameter
  - D. Statistical speed distribution: their significance and relation to the normal probability distribution

- III. Traffic Planning
  - A. Functional systems
  - B. Required surveys for system analysis
    - 1. Traffic count
    - 2. O-D surveys (trip purpose)
    - 3. Land use
  - C. Projection of data parameters, i.e., ADT, DHV, percent commercial, percent directional, trip purposes
  - D. Synthesis and proposals to existing system
  - E. Capacity analysis
    - 1. Roadway sections
    - 2. Intersections

- IV. Geometric Design

- A. Plane geometry for design vehicle
  - 1. Lane, shoulder, width, etc.
  - 2. C & C, E.M. turning radii
  - 3. Median strip width
  - 4. Deceleration and storage lane design
  - 5. Typical X-section
  - 6. Parking space requirements
- B. Vertical alignment
  - 1. Grades: uniformity, maximum, minimum
  - 2. Vertical curves
  - 3. Sight distance
- C. Horizontal
  - 1. Degree of curvature
  - 2. Required superelevation
  - 3. Superelevation transition

V. Traffic Control
- A. Signs
  - 1. Elements of signing
  - 2. Types or functions of signing
  - 3. Stop sign warrants
  - 4. Pedestrians and signing
- B. Delineation and channelization
- C. Signals
  - 1. Elements of signal control
  - 2. Cycle length
  - 3. Caution phase calculation
  - 4. Theory of total delay by cycle length
  - 5. Phasing of a traffic signal cycle
  - 6. Pedestrian warrants on traffic signals
  - 7. Coordination of traffic signals

COURSE LABORATORY OUTLINE: GENERAL

Lab

1 Measurement and calculation of basic driver and vehicle properties--vehicle dimensions, stopping sight distance, horsepower--grade requirements.

2 Statistical distribution of traffic stream; poisson arrivals and headways, percent commercial, and percent directional distributions.

3 Statistical distribution of spot speed and analysis with reference to the "normal probability distribution curve."

4 Analysis of plane geometry requirements for design vehicle.

5 Horizontal alignment--degree of curvature, superelevation and its transition.

6 Vertical alignment--grades, vertical curves, and sight distance requirements.

7 Analysis of signalized intersection--cycle length, phase lengths, exiting arrivals, calculation of DHV situation, pedestrian requirements.

8 Redesign and proposal for cycle length and phasing for above, Lab 7, signalized intersection situation.

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EXHIBIT E

PROPOSED COURSE DESCRIPTION
FOR
HIGHWAY ORGANIZATION AND OPERATIONS*

This course is meant to acquaint the student with the wide scope of the highway field and will cover the following areas: practical training for highway development, planning, construction, and administration; developing the ability of the student to make highway planning studies and surveys; developing an appreciation of economical advantage in proper highway planning, complexity of highway planning, and maintenance.

OUTLINE OF COURSE

1. Orientation lecture

2. Introduction
   a. Importance of highway transportation
   b. Growth of transportation systems
   c. Control and management of highway transportation

3. History of highway development
   a. Early roads
   b. Railroad influence

4. Highway systems
   a. Federal-aid system
   b. Federal-aid secondary system
   c. Urban federal-aide routes
   d. State highway systems
   e. County and local roads
   f. City streets
   g. Interstate system
   h. Strategic-net highways
   i. U.S. highways

5. Highway organizations
   a. Bureau of Public Roads
   b. State Highway Departments
   c. Local road administration

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*Selected from the "Highway Construction Technology Curriculum," the Wilkes-Barre Campus, Pennsylvania State University, Wilkes-Barre, Pennsylvania, 1970.

6. Highway associations
    a. A.S.S.H.O.
    b. Highway Research Board
    c. Other highway associations

7. Highway planning surveys
    a. Development
    b. Road inventory surveys
    c. Rural traffic surveys
    d. Urban origin and destination studies
    e. Studies of highway financing
    f. Ownership and use studies
    g. Road life studies

8. Benefits of highway improvement
    a. Primary benefits
    b. Secondary benefits

9. Cost of highways

10. Highway plans and specifications
    a. Preparation
    b. Interpretation
    c. Use
    d. Supervision

11. Rights-of-way
    a. Development
    b. Procedure of acquiring property
    c. Basis of payment for acquired property
    d. Reserving R.O.W.
    e. R.O.W. problems and descriptions

12. Highway design
    a. Introduction
    b. Driver characteristics
    c. Sizes and weights of motor vehicles
    d. Highway capacity
    e. Design speeds

13. Highway drainage
    a. Introduction
    b. Hydrology
    c. Examples and problems

14. Traffic engineering
    a. Introduction
    b. Traffic control devices
    c. Arterial routes
    d. One-way streets
    e. Highway safety

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15. Highway maintenance
    a. Introduction
    b. Surface maintenance
    c. Roadside and drainage maintenance
    d. Shoulder and approach maintenance
    e. Snow and ice control
    f. Traffic service
    g. Maintenance costs

16. Highway safety
    a. Accident data applied to highway design

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EVALUATION

Please complete the following regarding the unit you have just completed. Your ratings and comments should be concerned with the substantive content presented.

Since this assessment is of importance to the project, please complete and return this form as soon as conveniently possible.

DIRECTIONS: On the scale provided please rate each section in this volume. A rating of 1 indicates the section was inadequate. A rating of 4 indicates that the section was adequately presented. Space is provided after each item for any comments or questions. These comments and/or questions could be, but are not necessarily limited to, the strengths and/or weaknesses of each section.

	Inadequate			Adequate
1. Alcohol in Relation to Highway Safety	1	2	3	4

COMMENTS:

2. Identification and Surveillance of Accident Locations	1	2	3	4

COMMENTS:

3. Traffic Records	1	2	3	4

COMMENTS:

	Inadequate			Adequate
4. Emergency Medical Services	1	2	3	4

COMMENTS:

5. Highway Design, Construction, and Maintenance	1	2	3	4

COMMENTS: